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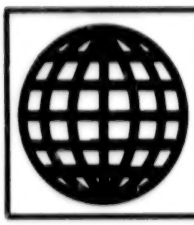

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JPRS Report

Science & Technology

Central Eurasia

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Science & Technology
Central Eurasia

JPRS-UST-94-031 23 November 1994

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Reaction of Ultradisperse Titanium Nitride Powder With Chromium Electrolyte

947M0014A St. Petersburg ZHURNAL PRIKLADNOY KHIMII in Russian Vol 66 No 9, Sep 93 (manuscript received 10 Sep 93) pp 1977-1983

[Article by T.V. Rezchikova, Ye.N. Kurkin, O.M. Gredtsova, V.N. Troitskiy, A.V. Ivanov, A.Z. Radhmatullina, and O.D. Torbova, New Chemistry Problems Institute, Russian Academy of Sciences, Chernogolovka; UDC 621.3.035.4:546.76]

[FBIS Abstract] Ultradisperse titanium nitride was obtained by two methods as follows: 1) in the nitrogen plasma of a microwave discharge by hydrogen reduction of titanium tetrachloride and 2) by decomposition of TiH_2 in an arc discharge. The titanium powder was added to a standard chromium electrolyte (CrO_3 in a concentration of 180-250 g/l and H_2SO_4 in a concentration of 1.8-2.5 g/l) until a TiN concentration of 8 g/l was reached. The electrolyte-and-powder mixture was heated to 55°. In a parallel experiment, the dissolution of commercially produced coarse-grained TiN in the chromium electrolyte was also examined. The dependence of the content of Ti(IV) and Cr(III) ions in the composite electrolyte on the length of heating at different temperatures was determined by diffraction and photometric analysis. As the TiN concentration was increased from 8 to 24 g/l, the concentration of Cr(III) ions in the electrolyte increased from 2.2 to 6.5 g/l. When TiN was added to the electrolyte in concentrations not exceeding 15 g/l, CR(III) ions formed without any preliminary electrical treatment of the electrolyte. The amount of Ti(IV) ions in the electrolyte proved to be independent of the method used to produce the TiN or its particle size. The TiN added to the chromium electrolyte was transformed into TiO_2. Because the TiO_2 in the electrolyte assumes the form of a highly disperse precipitate with a specific surface many times greater than that of the starting TiN powder, it has a favorable effect on the process of dispersion strengthening of the metal powder. The time required for an equilibrium state to be reached in the electrolyte after the TiN had been added was found to depend on the heating temperature and the size of the TiN particles added to the electrolyte: The higher the heating temperature and the finer the powder, the faster the electrolyte reached a state of equilibrium. Composite electrolytes produced by using ultradisperse TiN powder reached their equilibrium state and thus became ready to use after 250 hours of heating at 55° or 20-60 hours of heating at 75-85°. Figures 6, table 1; references 12 (Russian).

Use of Petroleum Residues To Produce Ion Exchangers

947M0014A St. Petersburg ZHURNAL PRIKLADNOY KHIMII in Russian Vol 66 No 9, Sep 93 (manuscript received 18 Nov 92; after revision Jun 93) pp 2059-2063

[Article by Yu.V. Pokonova, St. Petersburg Technological Institute; UDC 661.183.123]

[FBIS Abstract] The potential use of petroleum residues in the production of ion exchangers was examined. The experiments were performed with asphaltite with a molecular weight of 1,520, density of 1,113 kg/m^3, and the following components (percent by weight): C, 85.35; H, 8.26; N, 0.77; S, 6.01; and O, 1.61. Freshly distilled styrene with a boiling point of 144-146° was mixed with the asphaltite in a 1:1 ratio, sealed in ampules, and irradiated with γ-radiation with an activity equivalent to that of 20,000 g radium in a dose of 9 x 10^7 Gy at a dose rate of 0.8 mrad/h. The irradiated ampules were then placed in a thermostatted chamber for additional hardening at 100° for 15 hours. The resultant monoliths were crushed and separated into fractions. The fraction with a particle size of 0.25 to 1 mm was then subjected to chloromethylation by the liquid-phase method. The chloromethylation product was then phosphorylated in an excess of PCl_3 at a chloromethylated asphaltite:$FeCl_3$ ratio of 1:2 for 90 minutes. The phosphorylation product was rinsed, dried, transformed to H^+ form, and analyzed. The resultant cation exchanger was characterized by the following indicators: static exchange capacity, 3.5 mg-Eq/g; mechanical strength, 94 percent; volume weight, 0.63 g/ml; specific volume when swollen, 1.78 ml/g; swelling capacity, 9.7 percent; and moisture content, 6.2 percent. The cation exchanger was in the form of a dibasic acid that had a pK_1 of 4.6 and pK_2 of 8.5 and that could be used in a broad range of media (pH = 4 to 9). Its static exchange capacity peaked after 36 hours. The concentration of solution was found to affect the cation exchanger's ion-exchange capacity; however, its static exchange capacity during absorption of a potassium ion of the same valence as the proton did not change with dilution. In cases of exchange involving cations of different valence, the cation exchanger's static exchange capacity increased as the solution was diluted. Its ion sorption selectivity was determined as follows: Li > Na > K. Further tests of the new cation exchanger established that when it is used to exchange Na^+ for K^+, the free energy of K^+-N^+ ion pair exchange changes sign depending on the pH of the solution. The new petroleum residue-based cation exchanger can be used at 110°. Figures 3, tables 3; references 5 (Russian).

Alloy Formation by Electrodeposition of Chromium on Niobium Cathode in Fused Salts

947M00141A St. Petersburg ZHURNAL PRIKLADNOY KHIMII in Russian Vol 66 No 9, Sep 93 (manuscript received 5 May 93) pp 2108-2110

[Article by S.A. Kuznetsov, A.L. Glagolevskaya, Chemistry and Technology of Rare Elements and Mineral Ore, Kola Scientific Center, Russian Academy of Sciences, Apatity; UDC 541.135.3]

[FBIS Abstract] The process of forming alloys by electroprecipitation of chromium from fused salts on a niobium cathode was studied in a series of experiments involving Cr_2Nb that was prepared in an inert atmosphere in an arc furnace and then subjected to homogenizing annealing. The alloy was prepared by using vacuum-melted niobium

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and chromium that had been subjected to aluminothermal reduction followed by electrorefining in a salt melt. The main impurities in the metallic chromium were as followed (percent by weight): Mn < 3 x 10^{-3}; Mg < 3 x 10^{-3}; Si < 1 x 10^{-3}; Fe ≤ x x 10^{-2}; Al < 1 x 10^{-2}; Cu < 1 x 10^{-3}; Ni < 1 x 10^{-2}; Mo < 1 x 10^{-3}; and C < 4 x 10^{-3}. It oxygen, nitrogen, and hydrogen contents were as follows: ≤1 x 10^{-3}, <3 x 10^{-4}, and ≤2 x 10^{-3}. The chromium was electrodeposited onto a niobium from an NaCl-KCl-$CrCl_2$ melt (5 weight percent). The alloying was performed in an atmosphere of argon that had a grade of pure and that had first been heated to a temperature of 1,073 K. X-ray spectral electron probe microanalysis, x-ray phase metallographic analysis, and electrochemical analysis confirmed the formation of the intermetallic compound $Cr_{0.66}Nb_{0.33}$. Its thermodynamic characteristics were determined by the chronopotentiometric. The enthalpy of formation of $Cr_{0.66}Nb_{0.33}$ that was obtained by the authors of the present study was recalculated for a temperature of 298 K, i.e., -6.23 kJ/mol, it proved consistent with the results that Kubashevskiy et al. obtained by the calorimetric method (i.e., -6.98 +/- 0.97). Figure 1; references 10: 9 Russian, 1 Western.

Sorption of Cesium and Strontium From Mineralized Aqueous Solutions Based on Natural Aluminosilicates Modified by Ferrocyanide Heavy Metals

947M0014D St. Petersburg ZHURNAL PRIKLADNOY KHIMII in Russian Vol 66 No 9, Sep 93 (manuscript received 12 Apr 93) pp 2119-2122

[Article by A.S. Panasyugin, N.Ye. Trofimenko, N.P. Masherova, A.I. Ratko, and N.I. Golikova, General and Inorganic Chemistry Institute, Byelarus Academy of Sciences, Minsk; UDC 541.183:546.36]

[FBIS Abstract] The selectivity of extraction of long-lived cesium and strontium isotopes from highly mineralized solutions by modified natural aluminosilicate sorbents was studied in a series of experiments performed on montmorillonite and clinoptilolite. The montmorillonite and clinoptiloiite were modified in accordance with the conventional method by successive ion exchange attachment of metal cations and a ferrocyanide anion to their surface so as to form a composite ferrocyanide sorbent. Next, they were allowed to adsorb the long-lived isotopes ^{90}Sr and ^{137}Cs under static conditions in model solutions containing Na^+, Ca^{2+}, Mg^{2+}, and Cl^- in a 1:5:5:25 ratio as a salt background. The salt background's total ion content was varied up to a concentration of 1.2 g/l. The solution's starting activity with respect to ^{137}Cs and ^{90}Sr equaled 1.75 x 10^{-6} and 2.75 x 10^{-6} Ci/l, respectively. Modification of the natural aluminosilicates (bentonite and clinoptilolite) by heavy metal ferrocyanides had varying effects on their ability to adsorb $^{137}Cs^+$ and $^{90}Sr^{2+}$. In the case of bentonite, modification by ferrocyanides of various metals did not significantly change (within the bounds of the determination error) its coefficient of purification [K_p] and distribution [K_d] with respect to $^{90}Sr^{2+}$. In the case of samples of modified clinoptilolite, on the other hand, the values of K_d and K_p were increased for copper ferrocyanide, unchanged for iron ferrocyanide, and decreased for nickel ferrocyanide. Modification of the aluminosilicates by metal ferrocyanides did, however, result in a significant increase by a factor of 1.65 to 4.00) in K_d with respect to $^{137}Cs^+$. This change in specificity with respect to $^{137}Cs^+$ was attributed to the appearance in the aluminosilicate of synthesized metal ferrocyanide sorbents that are more selective to cesium ions. Because the ferrocyanides are located on the aluminosilicates' surface, the sorbents fall into the category of thin-film sorbents and are thus free of the diffusion problems inherent to pure ferrocyanides. For this reason, the indicators characterizing the kinetics of the sorption process on them are much better than those characterizing pure ferrocyanides. The K^p values obtained for all of the composite sorbents synthesized remained unchanged given salt backgrounds of up to 0.17 g/l. Higher concentrations of salts in the solution (up to 1.2 g/l) resulted in decreases in K^1 of 30-40 percent with respect to cesium. Clinoptilolite modified by nickel ferrocyanide was the least sensitive to increases in background salt concentrations: With a background salt concentration of 1.2 g/l, its K_p only decreased by 21 percent. Figures 2, table 1; references 11: 8 Russian, 3 Western.

Study of the Sorption of Vapors of Asymmetric Dimethylhydrazine by Peaty Soil

947M0014E St. Petersburg ZHURNAL PRIKLADNOY KHIMII in Russian Vol 66 No 9, Sep 93 (manuscript received 19 Jul 93) pp 2123-2126

[Article by T.B. Zaytseva, B.M. Laskin, N.R. Shistko, and V.G. Pimkin, Applied Chemistry Russian Scientific Center, St. Petersburg; UDC 546.17.5:66.081]

[FBIS Abstract] The sorption of asymmetric dimethylhydrazine vapors by peaty soils was examined. Sorption isotherms were plotted by the dynamic method at temperatures of 32 to 50°, and the differential heats of sorption according to which sorption interaction of asymmetric dimethylhydrazine with the soil surface is established were calculated by using a Clausius-Clapeyron thermodynamic equation. Because the process of sorption of asymmetric dimethylhydrazine vapors from the air was known to be accompanied by catalytic oxidation of the asymmetric dimethylhydrazine molecules, the weighted samples of asymmetric dimethylhydrazine used in the experiments were subjected to vacuum treatment and the sorption process was conducted in a nitrogen atmosphere. The experiments established that in cases of sorption amounting to approximately 0.25 mol/kg, the differential heat at which asymmetric dimethylhydrazine is sorbed by peaty soils approximates the heat of condensation, which means that physical sorption mechanisms predominate. As the amount of sorbed substance decreases, the values of the differential heats of sorption increase (because of a stronger interaction of the asymmetric dimethylhydrazine with the sorption centers of the soil particle surfaces). In the case of soil that has not previously absorbed any asymmetric dimethylhydrazine, the heat of sorption reaches values on the order of 170 kJ/mol. Such heat is

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characteristic of chemical reactions and is an indication of the fact that asymmetric dimethylhydrazine molecules are reacting chemically with the functional groups of the peaty soil's surface. As the amount of sorbed material increases, the contribution of van der Waals sorption (the heat of which is on the order of the heat of condensation of asymmetric dimethylhydrazine) increases. Sorption of asymmetric dimethylhydrazine by peaty soil is monomolecular at gaseous-phase concentrations of asymmetric dimethylhydrazine of <10.5 mmol/l, at which point the sorptivity of peaty soil reaches 0.25-0.30 mol/kg. Sorption is polymolecular in the near-saturation range of gaseous-phase asymmetric dimethylhydrazine concentrations. It is evident from the values obtained for the heats of chemisorption and physical sorption that removal of the asymmetric dimethylhydrazine molecules retained by chemisorption centers is the limiting process in detoxication of the soil by thermosorption. Figures 2, table 1; references 4 (Russian).

Sorption and Chromatographic Properties of Polyacrilonitrile Polymers

947M0014F St. Petersburg ZHURNAL PRIKLADNOY KHIMII in Russian Vol 66 No 9, Sep 93 (manuscript received 22 Mar 93) pp 2127-2130

[Article by O.G. Vokina, L.P. Shaulina, I.P. Golentovskaya, and S.V. Amosova, Irkutsk State University, Irkutsk State Medical Institute, and Irkutsk Organic Chemistry Institute, Siberian Department, Russian Academy of Sciences; UDC 541.64:543.544'661.813]

[FBIS Abstract] Porous copolymers of acrylonitrile and divinylsulfide were produced by suspension copolymerization of acrylonitrile and divinylsulfide in the presence of isoamyl alcohol. The copolymers were subjected to hydrolysis with 96 percent sulfuric acid for 30 minutes. Their pore structures were determined by mercury porometry and low-temperature desorption. They were also studied by gel-permeation chromatography. Their ability to adsorb silver and gold was established by the static method in nitric acid and sulfuric acid solutions (for silver) or in hydrochloric-sulfuric acid solutions (for gold). The copolymers produced and studied were characterized by a diverse pore structure that included both transition pores ranging from 5×10^{-7} to 2×10^{-5} cm and macropores larger than 2×10^{-5} cm. Gel-permeation chromatography tests confirmed that the acrylonitrile-divinylsulfide copolymers can be used to isolate high-molecular-weight compounds with molecular weights up to 1,000,000. The new copolymers' sorption properties were much better than those of the starting acrylonitrile and divinylsulfide. This improved sorption was attributed to the fact that the copolymers were subjected to hydrolysis, which resulted in the formation of carboxyl and amide groups and sulfur sulfide atoms in their structures and which changed their pore structure (i.e., reduced their specific surface to 2.5 m^2/g). The new copolymers were stable in hydrochloric, sulfuric, and nitric acid media at pH levels of 0.1 to 7.0. They were capable of sorption of gold at rates of 170 and 230 mg/g from 5 M solutions of hydrochloric and sulfuric acids, respectively, and were capable of sorption of silver at rates of 130 and 50 mg/g from nitric acid and sulfuric acid solutions, respectively. The acrylonitrile-divinylsulfide copolymer were capable of extracting trace quantities of silver and gold from solutions containing significant excesses of nonferrous metals at rates of 90-94 percent. Figures 4, table 1; references 6 (Russian).

CHEMICAL INDUSTRY

Chemical Precipitation of Ni-W-P Films on Surface of Gallium Arsenide Single Crystals

947M0094A Minsk VESTNIK BELORUSSKOGO GOSUDARSTVENNOGO UNIVERSITETA. SERIYA 2. KHIMIYA BIOLOGIYA GEOGRAFIYA in Russian No 1, Feb 94 pp 15-19

[Article by L. I. Stepanova, L. V. Barkovskaya, and O. G. Purovskaya; UDC621:793.3:315]

[FBIS Abstract] Practical use of chemically precipitated films of metals is frequently encumbered by difficulties in obtaining satisfactory adhesion to the substrate. Further difficulties arise in those cases where the substrate could be subjected to partial dissolution in the metallizing solutions, and for this reason the conditions for satisfactory precipitation of metal films on some particular substrate may prove to be unacceptable. In the present work a study was made of the conditions required for precipitation of Ni-W-P films on gallium arsenide single crystals 300 mkm thick. Coatings containing 7 mole percent tungsten and 9 mole percent phosphorus with good adhesion to the substrate were prepared from hot neutral (80-90° C) or slightly alkaline (Ph 7-9) solutions containing sodium citrate as a source of Ni^{2+} ions. The results indicate that it is possible to deposit both thin and thick coatings of Ni-W-P on gallium arsenide surfaces by precipitation from solution that have good adhesion, and that the possibility exists for using this process in the metallization of grounded openings in gallium arsenide substrates in integrated circuits. Figures 3; references 12: 3 Russian, 9 Western.

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Babayan Comments on Russian Supercomputer Accomplishments

957G0007 Moscow NAUKA I BIZNES in Russian No 15, Sep 94 p 4

[Interview by NAUKA I BIZNES correspondent Nataliya Lazareva with Boris Babayan, director of the Moscow Center for SPARC-Technologies]

[FBIS Translated Text] The Moscow Center for SPARC-Technologies is headed by world-renowned scienti st Boris Babayan, corresponding member of the Russian Academy of Sciences. The center works closely with Sun Microsystems, an American company, and is conducting research in the area of new architectures to support language translators. The center i s an official Sun distributor.

Babayan gave an interview to NAUKA I BIZNES correspondent Nataliya Lazareva.

Lazareva: Today there are many publications, especially in the foreign press, devoted to the achievements of your center. Could you tell our readers how things are going?

Babayan: Things are going very well now. When we had just begun working with Sun, the press here was afraid that the Americans would "use us cheaply." No one could have predicted that the collaboration would be so productive. At present, 150 persons are working at the center on a contractual basis, and we have created branches in St. Petersburg, Novosibirsk, and Tashkent. We are working on four contracts with Sun. The most important and the most successful is the first, which involves developing a new chip architecture. Language support and modernization of UNIX for Sun is going well. What was really difficult to predict was that our distributorship activity would be so very successful. We are in first place in Russia in the distribution of our partners' products. Now we have yet another contract, with Compass Design Automation, to prepare CAD packages for them.

Lazareva: But mainly your work is involved with chip architecture... Many specialists have stated directly that you are pioneering post-RISC architecture.

Babayan: It is generally known that several months ago Hewlett Packard announced that it will use ideas similar to those that we developed in our Russian supercomputer, the Elbrus-3, in their next post-RISC architecture. My colleagues and I devoted many years to the Elbrus-3. Shortly thereafter, a similar announcement was made by Intel. There is nothing surprising about this. RISC has outlived itself, and the ideas used in the Elbrus began to be developed some time ago both here and in the West. However, no one, except us, brought them to the commercial level. The specialists at Sun have always looked a few steps ahead, so they made contact with us. They gave us the opportunity to work in peace, but at first our approach was considered experimental. Now, these same ideas are being thrust into the forefront. We have worked with these ideas for many years, and so we didn't miss the boat. That's why I would say that we are in the lead when it comes to future architectures and that we are already leading the world.

Lazareva: And the Elbrus-3, which everyone has forgotten, is in the forefront?

Babayan: The most terrible thing is that government funding for the completion of Elbrus has virtually ceased. The machine is actually ready, and only a few small details remain, but there is no money to pay the factory that is producing a number of the elements, and there are some problems paying for the electrical supply. The Sparc center helped where it could, but the creation of a Russian supercomputer is in the domain of the government alone. It is simply a gross injustice, that this work has not been completed.

Lazareva: But aren't you preparing for a change, aren't you preparing people who won't make the same mistakes?

Babayan: The personnel at the Sparc center are mainly young highly-skilled specialists. But we worry about the future; we have created a special network where students can work freely and acquaint themselves with Sun ideologies. Students of the Moscow Institute of Electronic Machine Building, the Physical and Technical Institute, and other institutes of higher learning are constantly practicing at the center .

Contact: 117312 Moscow, ul. Vavilova, 7. Telephone: (095)135-45-39; telephone/fax: (095) 135-54-69.

Tashkent branch telephone: (371) 267-22-08

Novosibirsk branch telephone: (383) 232-41-69

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OPTICS AND HIGH-ENERGY TECHNOLOGY

Industrial 3-kW CO_2 Laser With High Radiation Quality

947F0230A Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 21 No 7, Jul 94 (manuscript received 10 Aug 93) pp 643-646

[Article by A. I. Ivanchenko, V. V. Krasheninnikov, A. L. Smirnov and V. B. Shulyatyev, Laser Physics Institute, Siberian Department, Russian Academy of Sciences, Novosibirsk]

[FBIS Abstract] The results of development and study of a laser system based on an LOK-3M cw CO_2 laser are presented and the characteristics of the emitted radiation are analyzed. An unstable self-filtering resonator cavity is used in this laser. The active medium is excited by an independent discharge of a d-c current in two discharge gaps in a common gas flow. The directions of the gas flow, electric current and cavity axes are mutually perpendicular. The anode is a copper plate with a width along the flow 100 mm, surrounded on both sides by the flow; the cathodes are copper water-cooled tubes with an outer diameter 16 mm and 800 mm in length, positioned on both sides of the plate near the dielectric channel walls. The distance between the plate and each of the cathodes is 50 mm. A CO_2-N_2He mixture is pumped through a closed circuit by a centrifugal fan and the flow speed at the input into the discharge gaps is 45 m/s. This design made it possible to generate, with the use solely of totally reflecting mirrors, a beam which has a divergence which is only 1.5 times greater than the asymptotic divergence angle of a Gaussian beam with the same waist diameter. A numerical analysis is made of the influence of the deviation of the cavity parameters from stipulated values on the diffraction losses and beam characteristics. Figures 6; references 10: 7 Russian, 3 Western.

Cooled Bimorphic Adaptive Mirrors for Laser Optical Systems

947F0230B Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 21 No 7, Jul 94 (manuscript received 28 Sep 93) pp 665-669

[Article by A. V. Ikramov, I. M. Roshupkin and A. G. Safronov, Kompozit Scientific Production Association, Kaliningrad]

[FBIS Abstract] It is proposed that bimorphic adaptive mirrors be used for compensating for large-scale optical aberrations in laser systems with a power up to 15 KW. The diameter of these mirrors is 76 mm, the height is 9.5 mm and the thickness of the cooled mirror plate is 1.5 mm. The cooling system is of the waffle type. Adaptive mirrors of this design were fabricated in two variants: copper and molybdenum. The thermal deformations of these mirrors were studied. The minimum thermal deformations are characteristic for the Mo variant; with a change in ambient temperature these deformations are virtually undetectable. This could be expected because the thermal expansion coefficient for the piezoceramic used is far closer to the thermal expansion coefficient of Mo than Cu. The mirror response functions were studied in two ways: computer simulation by the finite elements method and interferometry with subsequent processing on a PC. There was good agreement between the computed and experimental data. The forms and frequencies of free oscillations of the unit were determined in a three-dimensional finite-element model and the amplitude-frequency characteristics were registered. An efficiency study revealed that these bimorphic mirrors eliminate axisymmetric wave front distortions and therefore their use for compensating for defocusing and spherical aberration is extremely effective. Although the mirrors have some shortcomings, ways to remedy these are suggested. They can be used in compensating for large-scale wave front distortions in the frequency range up to 1 KHz. Promising designs of adaptive bimorphic mirrors are proposed and discussed. Figures 9; references: 5 Russian.

Multipass CO_2 Amplifier With Four-Wave Phase Conjugation Mirrors

947F0230C Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 21 No 7, Jul 94 (manuscript received 8 Oct 93) pp 689-692

[Article by A. A. Betin, K. V. Yergakov, O. V. Mitropolskiy and D. V. Osipov, Applied Physics Institute, Russian Academy of Sciences, Nizhniy Novgorod]

[FBIS Abstract] The possibility of constructing a highly sensitive narrow-band adaptive laser system which combines phase conjugation mirrors for weak signal radiation with a considerable amplification of the conjugate wave and control of its parameters (rotation of propagation direction by a stipulated angle, time lag, change in pulse duration, frequency and degree of polarization of radiation) was outlined earlier (V. I. Bespalov, et al., IZV. AN SSSR. SER. FIZICH., 56, 29, 1992). The preamplification circuit is of independent interest because it can be used for considerable amplification without substantial distortions of weak optical signals for the purpose of their subsequent registry. This article describes in full detail the design of one of the most important components of this system, a narrow-band adaptive multipass amplifier with four-wave phase-conjugation mirrors. A three-pass CO_2 amplifier with two four-wave mirrors, based on thermal nonlinearity in a liquid (CCl_4), with a total amplification factor 2×10^{11}, is realized with pumping of the phase-conjugation mirrors by the radiation of two separate master oscillators. A block diagram illustrates system structure and function. Two- and four-pass operating modes were experimentally tested and had amplification factors 1.5×10^7 and 5×10^9 respectively. Figures 3; references: 3 Russian.

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Formation of Craters by Interaction of Powerful Ion Beams With Surfaces of Metals and Alloys: General Characteristic

957K0010A Moscow POVERKHNOST: FIZIKA, KHIMIA, MEKHANIKA in Russian No 7, Jul 94 pp 117-128

[Article by V. A. Shulov, G. Ye. Remnev, N. A. Nochovnaya, V. A. Koshcheyev, I. G. Polyakova, I. F. Isakov, Ye. V. Fedorova; UDC 539.213.612.17.533]

[FBIS Abstract] Methods of electron Auger spectroscopy, X-ray microanalysis, scanning electron microscopy in a polarized light and microhardness measurements were employed to examine chemical composition and surface morphology of heat resisting alloys after irradiation of the samples by powerful ion beams in the nanosecond range and thermal processing in vacuum. Titanium alloy and heat resisting iron-nickel alloy samples were examined. At high current densities and energy of carbon ions, E - 300 keV, a large number of crater was detected on the alloys surface. Tables are compiled listing thermal processing modes of the heat resisting alloys, distribution density and average dimensions of craters on surface of the examined samples after processing by powerful ion beams, and tables showing the effects of irradiation and annealing modes on the crater formation process occurring on the titanium alloy samples. Qualitative conclusions are drawn about the effect of the irradiation mode on the type, size and number of craters, and the mechanism of their formation is discussed. Figures 4, references 19: 13 Russian, 6 Western.

Superpowerful Free-Electron Lasers With a Two-Dimensional Distributed Feedback

957K0013A Moscow FIZIKA PLAZMY in Russian Vol 20, No 7-8, Jul-Aug 94 pp 627-633

[Article by N. S. Ginsburg, N. Yu. Peskov, A. S. Sergeyev, RAS Institute of Applied Physics; UDC 533.95:538.561]

[FBIS Abstract] Employment of a two-dimensional distributed feedback is proposed for obtaining a space-coherent radiation of broad ribbon relativistic electron beams (REB), whose transverse dimensions are several orders of magnitude greater than the wavelength. This type of feedback can be produced in a two-dimensional Bragg resonator, consisting of two metal plates parallel to the beam, with a doubly periodic corrugation of the lateral walls. The additional transverse flow of electromagnetic energy, which is generated in this resonator, synchronize the radiation of individual sections of the electron flow. Eigen modes of two-dimensional Bragg resonator are determined and its selectivity properties are examined. Numerical modeling of the two dimensional Bragg resonator excitation process by a ribbon REB demonstrate a feasibility of obtaining a single-mode coherent generation from beams with transverse dimensions of up to 10^2-10^3wavelength. The concept is described of a superpowerful Free Electron Laser (FEL) in the millimeter range with an up to 20 GW output power, using a 140 cm ribbon REB, formed by U-2 accelerator (Nuclear Physics Institute RAS Siberian Branch).

Tunable Solid-State Laser With a Feresterite Converter

957K0011A Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 21 No 9, Sep 94 pp 821-823

[Article by B. I. Minkov, P. N. Nazarenko, A. A. Stavrov; PACS 42.55. Rz; 42.60.Ll]

[FBIS Abstract] The efficiency of foresterite laser generation is calculated and some practical recommendations dealing with development of specific laser devices on foresterite are provided. Numerical computations indicate that with the existing element base, the generation efficiency of foresteite laser can not be significantly greater than 10%. Theoretically detected generation features of a foresterite converter were also experimentally examined using a YAG:Nd3+ laser excited by a light diode system. Aside from producing ultimately low-energy excitation conditions, which clearly reveal the uncovered generation features, it was possible to develop a completely solid-state foresterite laser. Because the resonator losses were optimized this laser provides a reliable functioning of the converter, and allows to obtain acceptable for many practical applications spectral-energy and space-time parameters. Experimental relationships of the foresterite laser generation energy as a function of pumping energy and generation efficiency as a function of the resonator output mirror reflection coefficient are shown in graphs. Figures 3, references 7: 5 Russian, 2 Western.

Dielectric Laser Mirror With Phase Anisotropy

957K0011B Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 21 No 9, Sep 94 pp 869-872

[Article by V. N. Beltyugov, S. G. Protsenko, Yu. V. Troitskiy; PACS 42.79.Bh; 42.55.Lt;42.60.Da]

[FBIS Abstract] This paper deals with development of fully dielectric mirrors where phase anisotropy is not limited by the quality factor of the mirror and where significantly greater differences in the reflection phase are theoretically possible for two orthogonal polarizations. A mirror construction which combines a multilayer dielectric element with a phase-type anisotropic element, located on the surface of the multilayer coating is proposed. Mirrors for 0.63 μm wavelength with a phase anisotropy of reflection were constructed and experimentally tested. Methods of photoresistive and laser technology were employed to produce a relief grating. Phase difference of the mirrors reflection and the module of amplitude anisotropy were measured on the 0.63μm wavelength. A table listing some experimentally obtained parameters of mirrors with a phase anisotropy of reflection is provided. It was demonstrated that laser quality mirrors can be obtained by combination of the surface grating with a dielectric multilayer at a sufficiently high phase anisotropy. Figures 2, table 1, references 10: 5 Russian, 5 Western.

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NUCLEAR AND NON-NUCLEAR ENERGY

Autonomous Specialized Electric Power Sources

947F0225 Moscow PROMYSHLENNAYA ENERGETIKA in Russian No 3, Mar 94 [Signed to press 17 Mar 94] pp 22-25

[Article by V. A. Atroshchenko, candidate of technical sciences, O. V. Grigorash, candidate of technical sciences, and V. V. Lanchu, engineer: "Autonomous Specialized Electric Power Sources"; copyright: Energoatomoizdat, "Promyshlennaya energetika", 1990]

[FBIS Translated Text] Autonomous sources of electric power are used quite commonly at the present time. They operate in various fields of the economy and can be accommodated both as mobile electric generators and in stationary energy installations.

Requirements for autonomous electricity supply systems are determined mainly by the recipients of the power produced and the operational specifics. For instance, in the design of mobile power plants, the basic criteria are weight and dimensions of the electric equipment and the efficiency, reliability and economic factors. In addition, the control system should ensure a good stability and accuracy in the maintenance of electricity parameters, even when exposed to destabilizing factors such as the variable rotation speed of the driving motor and the variability in the consumption patterns and amounts.

Mobile electric power plants are used as autonomous electricity sources by geologists, oil producers and lumbering enterprises in areas where a constant centralized electric power supply is absent. Effective rescue work and recovery operations in territories affected by natural disasters also require mobile electric power plants that can be brought in by transportation facilities (automobile, railroad, river, etc.). These efforts include supply of dc and ac electric power with various frequencies and voltages to the consumer equipment (lighting systems, cutting tools, welding equipment, all kinds of electric drives, etc.)

Another important feature in the power supply to such consumers is the fact that their demand for the quality of electricity is not overly stringent, a consideration essential in the choice of the drives, sources and converters of electricity and the design of the structure of a specialized autonomous electric power source.

Diesel power plants (DPP) commonly used today are furnished with a diesel engine and a synchronous generator (SG). They are not suited for production of electricity needed by specialized consumers. DPP also are characterized by some other important shortcomings: their relatively large weight and dimensions, a low efficiency, and the difficulty of parallel operation of power sources. Introduction of auxiliary functional assemblies (transformers, rectifiers, inverters, and filters) into DPP in order to convert industrial ac current to a dc voltage or to an alternating current of a different frequency and voltage would result in a substantial deterioration of the technical, economic and operational characteristics of an autonomous energy source. It is, therefore, important to develop new specialized autonomous energy systems that will support effective work in areas where permanent electric supply is unavailable.

Special-purpose electric power sources with improved technical and economic characteristics can be built on the basis of high-speed drive engines (HSDE) of gas-turbine, combined free-piston, and other types, which feature efficiencies of 40% and more and a service life of 80,000 to 100,000 hours [1,2].

The high rotation speeds of HSDE (up to 20,000 rpm and more) and the resulting high frequency of ac voltages produced in combination with available energy sources make it possible to greatly reduce the weight and size of generators, improve the dc voltage quality, and shorten the response time of the systems for protection and stabilization of the electricity parameters.

On the other hand, with increasing rotation speed of HSDE, more stringent requirements are imposed on the mechanical strength of the rotor of the electric machine, and its service life, which mainly depends on bearings, is reduced. For this reason, systems of autonomous electricity supply with HSDE must be based on noncontact ac generators, which will eventually become a foundation for the development of autonomous electric energy production with the range of outputs from tens to hundreds of kilowatts, as well as on gas and magnetic bearings, which are characterized by long service lives and operate on speeds of 30,000-100,000 rpm [3].

In this context, it is desirable to study the possibilities of noncontact electric power sources.

Noncontact SG with claw-shaped poles and inductor machines feature a high reliability and a low sensitivity to external impacts (high temperatures, dynamic loads, etc.), making them a good choice for operation in difficult conditions. However, these generators have not been widely used in autonomous power plants because of the following shortcomings: a low efficiency and a high relative volume and weight compared with the conventional SG, as well as a lower operation stability of regulation systems under a constant load [4].

SG with rotating rectifiers have better characteristics. Their specific weight is 3.6—8 kg/kW depending on the installed capacity, and the efficiency ranges from 32% to 95%. The main flaw of SG with rotating rectifiers, which prevents their use with HSDE, is that windings, semiconductor valves, protective elements, etc. are mounted on the rotor, which limits the permissible temperatures and maximum rotation speeds and lowers performance reliability [3].

SG with permanent magnets and asynchronous generators (AG) with capacitor excitation are a promising type of noncontact electric power sources. Their specific weight ranges from 1.2 to 2.2 kg/kW, and the efficiency from 89 to 93%, for generator power levels of 20—60 kW and rotor speed 8,000—12,000 rpm. The technical and economic characteristics of the generators are improved [3,5] with increasing rotor speed.

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During the past few years, theoretical studies and practical experience both in Russia and abroad have indicated that self-exciting AG used as an autonomous power source in medium-level electric supply systems are a promising alternative [6-8].

Applications of AG are limited mainly by two factors: the absence of small-sized power capacitors for generation and compensation of the reactive load power and the difficulties of stabilization of the output voltage. The polypropylene film solid-impregnated capacitors developed in recent years, modern noncontact capacity control devices, which use fast semiconductor keys, and achievements of microelectronics in control and monitoring systems have now removed the limitations to the use of AG in autonomous electric supply systems constructed on HSDE basis.

The flowchart of an autonomous specialized electric power source in each particular case will depend on the energy needs of consumers. The figure shows the alternatives (a) and (b) of a flowchart with inverters and direct frequency converters (DFC), respectively.

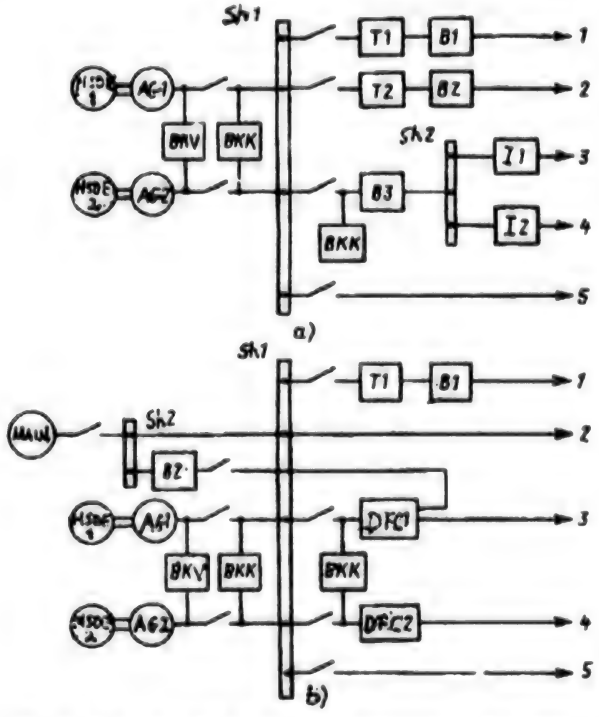

Figure. Structural diagrams of autonomous specialized power sources designed with the use of inverters (a) and direct frequency converters (b): HSDE1, HSDE2—high-speed drive engines; AG1, AG2—asynchronous generators; BKV, BKK—blocks of excitation capacitors and reactive power compensation capacitors; T1, T2—transformers; B1, B3—rectifiers; I1, I2—inverters; DFC1, DFC2—direct frequency converters; Sh1—high-frequency voltage bus; Sh2—standard power line voltage bus; 1-5—for connection of consumer equipment.

Under the rated duty, dc and ac power consumers are supplied by asynchronous generator AG1. If necessary, the installed capacity of the autonomous source can be increased by introducing into parallel operation asynchronous generator AG2. The converters have a certain redundant power margin.

Capacitor blocks BKV and BKK are responsible not only for the self-excitation of the generators and compensation of the reactive power load, but also for suppressing the switching overvoltages and for reducing the distortions of the generator currents. They improve the form of the output voltage curve, i.e., execute the functions of output generator filters and input filters of electric energy converters.

Rescue and recovery work is sometimes conducted for a relatively long period of time. The service time reserve of HSDE is limited by the available fuel supply. An autonomous power source should, therefore, be provided with an additional input lead so it could be connected to the standard power line (bus Sh2 in Fig. b) once electricity has been restored. Asynchronous generators AG1 and AG2 in this case are disconnected, and the DFC1 becomes the source of the high-frequency voltage (see Fig. b), which operates in the inverter mode.

The structural diagram of the autonomous source is illustrated by Fig. b. In addition to the possibility of connecting the unit to the main power line, it features improved technical and economic characteristics because of the use of DFC, which not only can smoothly vary the frequency and the output voltage, but also transmit energy in both directions, as well as change the phase shift angle at the converter input, regardless of the load value and type. A combined operation of AG and DFC thus will make it possible to reduce the weight of the capacitors used for compensation of the reactive power load, and the excitation of AG will be controlled by modifying the phase shift angle at the DFC input [2].

The autonomous specialized electric power sources designed with the use of HSDE and AG with capacitor excitation proposed in this paper will make it possible to improve performance in locations where permanent energy supply is unavailable. Additionally, they could have a wide range of applications in national economy (on aircraft, as ship power supply units, etc.).

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Determining Parameters of Underwater Relief Profile From Echo Sounding Measurements

957N0004A Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOSYEMKA in Russian No 1-2, Jan-Apr 93 (manuscript received 31 Jan 91) pp 34-39

[Article by A. L. Tezikov, assistant professor, candidate of technical sciences, Leningrad Order of the October Revolution Higher Engineering Maritime School imeni Admiral S. O. Makarov; UDC 528.47]

[FBIS Abstract] In regions with highly dissected relief the profiles registered using automatic echo sounders differ considerably from the true profiles (the discrepancies may attain tens and hundreds of meters). The lack of an acceptable theory of depth measurement and retrieval of true profiles is restraining the process of improving methods for processing the results of surveying of underwater relief. Accordingly, an attempt was made at partially filling this gap applicable to the theory of processing of individual profiles. Expressions are derived for the first and second derivatives of a function describing the bottom profile through the parameters of profiles measured by an echo sounder. The conditions for impairment of similarity of the shapes of the analyzed curves are formulated. The cited expressions show that under highly dissected relief conditions the plotting of precise marine charts for the solution of many special marine engineering problems, reliable interpretation of the forms of underwater relief, interpretation of gravimetric prospecting data, etc. is possible only with allowance for the properties of the profiles registered by echo sounders and the true depths at the points of reflection of acoustic signals. Figures 2; references 2: 1 Russian, 1 Western.

Analysis of Distortion of Form of Underwater Relief in Echo Sounding Measurements

957N0003A Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOSYEMKA in Russian No 4, Jul-Aug 93 (manuscript received 13 Jul 92) pp 82-87

[Article by A. L. Tezikov, assistant professor, candidate of technical sciences, State Maritime Academy imeni Admiral S. O. Makarov, UDC 528.2/.3]

[FBIS Abstract] For navigational purposes echo sounder distortions are neglected because they usually result in understated depths, which corresponds to the standards of safety in navigation, but in mapping for nonnavigational purposes the precise representation of underwater relief is required and the distortions introduced by measuring instruments must be taken into account. On the basis of an analysis of the second quadratic forms of surfaces a comparison is made of the properties of true underwater relief and the relief represented on marine navigation charts. A theoretical explanation is given for the impairment of similarity of the abyssal profiles registered by an echo sounder and the true profiles. In regions with great depths the impairment of correspondence of signs on curvature becomes an almost natural phenomenon because in the case of great depths the centers of curvature of concave relief forms, other than some very extended forms, are situated below the level from which measurements are made. As a result, in the case of great depths both concave and convex forms of true relief are registered as a system of convex curves. This phenomenon must therefore be taken into account for the correct interpretation of the results of measurement of depths with an echo sounder and when plotting charts adequately reflecting true relief. References 4: 3 Russian, 1 Western.

Analytic Method for Determining Elements of Inner and Outer Orientation of Archival Photographs

957N0003B Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOSYEMKA in Russian No 4, Jul-Aug 93 (manuscript received 20 Dec 92) pp 117-120

[Article by V. I. Nefedov, assistant professor, candidate of technical sciences, Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers; UDC 528.72]

[FBIS Abstract] Archival photographs are the sole source of information on the size and configuration of architectural monuments, but it is difficult to use such photographs for architectural reconstructions because the elements of their inner and outer orientation are unknown. Existing analytic methods do not allow calibration of archival photographs in those cases when information is lacking on the reference network and the architectural object has been completely destroyed and another structure has been built in its place. Accordingly, it is proposed that a mathematical expression for an analytic method described by the author in this journal (No 2, pp 85-92, 1987) be used in calibrating archival photographs. As a so-called "independent geodetic reference network" for the processing of archival photographs the following additional geometric conditions are introduced: condition that three or more noncollinear points fall in the same plane of the architectural structure; condition that two planes are parallel or perpendicular to one another; condition that individual straight lines are horizontal or vertical. In the theoretical validation of the proposed analytic method for determining the elements of inner and outer orientation of the photographs it is assumed that there are two different archival photographs which form a stereopair. If arbitrary elements of inner orientation are stipulated it is possible to use a traditional analytic method in constructing a model of the photographed object in a base photogrammetric coordinate system and by pursuing this line obtain the required additional geometric conditions. Figure 1; references: 4 Russian.

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Results of Study of Fluctuations in Intensity and Phase of Low Frequency Acoustic Signals in Stationary Tracks in the Shelf Zone of the Sea of Japan

957N0002A Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 40 No 4, Jul-Aug 94 (manuscript received 1 Sep 93) pp 561-570

[Article by L. F. Bondar, S. V. Borisov, A. V. Gritsenko, V. A. Zakharov, V. I. Ilichev, D. G. Kovzel, Yu. N. Morgunov, A. N. Rutenko, Pacific Ocean Oceanological Institute, Far East Division, Russian Academy of Sciences, Vladivostok; UDC 534,232]

[FBIS Abstract] A study was carried out using special equipment in a test range in the shelf zone of the Sea of Japan in a period with a pronounced seasonal thermocline and a bottom sound channel. The fluctuations of intensity and phase of low frequency hydroacoustic signals were experimentally studied along stationary tracks of various lengths (3.7, 23, and 25 km). The equipment used in the study is described briefly and measurement methods are explained. In situ data is statistically analyzed and compared with the experimental results of other authors. The spectra of phase fluctuations is independent of signal frequency and track length and falls proportionally to o^{-2}. The intensity fluctuation spectra fall as o^{-1} along a short track. On longer tracks spectral behavior depends on the average Brunt-Väisälä frequency in the thermocline layer over the length of the track. Lower frequency fluctuations fall slower than o^{-1}, and higher frequency fluctuations fall proportional to o^{-2}. More articles discussing these data are planned. Figures 5; references 8 (Russian).

Some Hydroacoustic Characteristics of an Explosion Signal

957N0002B Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 40 No 4, Jul-Aug 94 (manuscript received 30 Nov 93) pp 677-679

[Article by R. A. Vadov, N. N. And reyev Acoustic Institute, Moscow; UDC 551.46]

[FBIS Abstract] This paper presents the results of studies of spectral, energy, and temporal characteristics of explosion signals received in one-beam propagation at a distance of 1-10 km or more from the source when nonlinear processes can be ignored. Charges weighing 400 g were used. Only the shock wave and the first few pulsations of bubbles were observed. The period of the bubble pulses was constant and independent of the weight of the charge and the depth of the explosion (T_1:T_2:T_3 = 1:0.76:0.55. The dependence of the period of the first bubble pulse on the depth of the explosion is described by a $T1/z^{1.1}$ law. The signal spectrum is characterized by strong interference irregularity. The position of the first maximum and the distribution between neighboring maxima is linked with the period of the first pulsation of bubbles (T_1) as $f_0 x T_1 = \Delta f x T_1 = 1$. This is observed to 3-5 kHz, then breaks down (at which point the shock wave is the main energy carrier). The drop in spectral energy density with frequency follows a nearly 1/f law to 1 kHz and a nearly $1/f^{2.5}$ law above 1 kHz. A monotonic change in spectral density with frequency is observed. Figures 3; references 5: 3 Russian, 2 Western.

Comparative Evaluation of Formulas Used in Allowing for Influence of Troposphere and Stratosphere on Results of Measurement of Range to Space Objects by Electronic Devices

957N0005A Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOSYEMKA in Russian No 3, May-Jun 93 (manuscript received 27 Apr 93) pp 3-8

[Article by G. A. Shanurov, assistant professor, candidate of technical sciences. and V. B. Remneva, engineer; Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers; UDC 528.2:[52-77+620.27]

[FBIS Abstract] The lags in propagation of electromagnetic waves in the neutral atmosphere are computed as a function of zenith distance using different formulas. The Saastmoinen, Marini and Ong formulas are used, as well as newly derived formulas based on the Marini formula which take the influence of the surface atmospheric layer into account separately. The basis for the comparison is the results obtained using a rigorous integral formula. The deviation of the data obtained using the new formulas from these results is about 1%, whereas the known formulas give deviations up to 19% at great zenith distances. The Ong formula is recommended when computing the lag of the dry component. The Marini formula is essentially an improvement over the Saastmoinen formula. They give identical results up to a zenith distance 75°, but this cannot serve as a reliable control of the accuracy of the results. The difference in the new method, based on the Marini formula, is that the vertical scales for the troposphere and stratosphere are different; for the stratosphere it is 6.2 km. Still another difference is that the influence of the tropospheric surface layer with a thickness 3 km is estimated separately. This is done using a quadratic model of the distribution of the refractive index with altitude; its parameters are consistent with the parameters of the used exponential (biexponential) model. Figure 1; references 5: 4 Russian, 1 Western.

Research on Accuracy of Translocation Method When Determining Coordinates of Points Using GLONASS Navigation Satellites

957N0005B Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOSYEMKA in Russian No 3, May-Jun 93 (manuscript received 5 Jan 93) pp 78-87

[Article by V. V. Taran, graduate student, Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers; UDC 528.2:629.78]

[FBIS Abstract] Mathematical simulation was carried out for investigating the accuracy in determining the coordinates of new points from three or four initial points for

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transforming the coordinates of a GLONASS high-orbit navigational satellite. A study was made to ascertain the accuracy in determining the rectangular geodetic coordinates of a point as a function of frequency and accuracy in measuring distances within one session (within the limits of a single visibility), with subsequent use of observations over the course of such visibilities. The frequency υ of range measurement was 1 and 1/15 measurements per second. Ranges were determined with rms errors of 10 and 50 cm. A change in frequency from υ = 1/15 to υ = 1 results in a decrease in the error by a factor of 6.8-8.2. The described so-called translocation method with the use of range finding measurements to the GLONASS satellite makes it possible to transform the coordinates with a high accuracy over the course of one or two visibilities (with an rms error in measuring ranges 10 cm and a frequency υ = 1 the true error is 2-7 mm); an increase in the accuracy of measuring ranges by several times will make possible a corresponding decrease in the error in transforming coordinates; in order to avoid a worsening of the results the measuring interval must be limited to two visibilities. Figures 4; references: 2 Russian.

Combined Method for Automated Interpretation of Space Images of Snow-Ice Formations

957N0005C Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOSYEMKA in Russian No 3, May-Jun 93 (manuscript received 1 Apr 93) pp 130-139

[Article by A. K. Chudinov, graduate student, Moscow Order of Lenin Institute of Geodetic, Aerial Mapping and Cartographic Engineers; UDC 528.77]

[FBIS Abstract] The state of the art in the automated interpretation of space images of snow-ice formations is reviewed and the merits and shortcomings of each system (American, Japanese, German, Russian) are critically examined. A combined method is proposed which incorporates both automated and statistical processing of bispectral images. A block diagram of the automated processing of space images of snow and ice formations using decision rules based on the emission curve of snow and ice formations and a special classification method is presented and discussed in detail. Formulas are derived relating the brightness characteristics of these formations and the normalized values of the computer code for the corresponding parts of the space image. The processing of space scanner images is divided into visual-instrumental and automatic parts and these procedures are represented in a second block diagram. Visual-instrumental processing involves interpretation using instruments for the synthesis and checking of the results on the basis of a file of interpretation keys. Automatic processing includes preliminary processing, which makes it possible to reduce satellite information to a form convenient for use of computer classifiers, computer interpretation and visualization of the results. At the same time, in order to increase reliability, correlation processing of images is carried out using a cross-correlation function of bispectral scanner images, making it possible to compute the statistical characteristics of the images using an arbitrarily selected set of points, thereby making it possible to reduce the volume of computations and exclude foreign objects from consideration. Figures 2; references 10: 8 Russian, 2 Western.

Guaranteeing the Protection of Digital Cartographic Information

957N0019 Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 6, Jun 94 pp 44-50

[Article by V. I. Kozyr, A. M. Kolesnikov, L. G. Pallo; UDC 528.93:516]

[FBIS Abstract] Personal computers and LANs are increasingly being used to generate digital and electronic cartographic material. This material may contain sensitive information or commercial secrets. Thus, protection of information from exposure and alteration is a top priority problem. A year-long study was conducted to determine what must be done in this field. It was determined that standards for information protection must be formulated, groups exclusively devoted to information security must be established at enterprises involved in cartography, and computer protection software or hardware must be installed. Criteria for determining the necessary degree of security are presented. Measures being taken at one Russian cartography facility are listed. Documents developed during the year-long study which will serve as guidelines for developing information protection methods and analyzing current practice are described. Safeguards to be taken include the certification of protection systems. If an uncertified system is in use on 1 Jan 1995, the government may shut down the enterprise until certification is completed. A testing center for certification of systems is to be established. References 16 (Rus sian).

Carbon in Forest Ecosystems

957N0008A Moscow PRIRODA in Russian No 7, Jul 94 pp 18-21

[Article by A.S. Isayev, academician, director, Center for Ecologic Problems and Forest Productivity, Russian Academy of Sciences]

[FBIS Abstract] It is essential to determine the place of Russian forests in the global carbon cycle and devise means for controlling forest ecosystems in order to enhance their role as regulators of the gas composition of the atmosphere. A study was therefore made to arrive at new computed quantities of carbon reserves in the forests of different regions of Russia. The following conversion factors were introduced: for 1 kg of the dry mass of trunks, branches and roots—0.5 kg of carbon, for 1 kg of the dry mass of needles and leaves—0.45 kg. These factors were used in estimating the reserves of phytomass of forest ecosystems and in transforming them into carbon reserves in order to ascertain the role of forests in the global carbon cycle. Estimates of the reserves and deposition of carbon for forest vegetation, such as given in a number of tables, are exceedingly important for determining the norms for release of carbon dioxide in order to limit the greenhouse

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effect and this quantity was ascertained for different tree species and different categories of land use areas. It was found that the carbon reserves in the living parts of plants over the entire forested area of Russia are 41.2 Gt, of which 39.8 Gt are in the forest-covered area. During the year the depositions in these same areas are 212 and 184 Mt respectively. This represents only the first stage in the research because calculations for individual regions and subregions must be made. This will serve as a basis for ecological modeling of biospheric processes. Figures 2; references: 1 Western.

Carbon Budget in Tundra and Wooded Tundra Zones

957N0008B Moscow PRIRODA in Russian
No 7, Jul 94 pp 22-24

[Article by D. G. Zamolodchikov, candidate of biological sciences, senior scientific specialist, Center for Ecologic Problems and Forest Productivity, Russian Academy of Sciences]

[FBIS Abstract] The most recent scenarios of impending climatic changes suggest the possibility of quite significant and rapid climatic changes in arctic and subarctic regions. The total carbon reserve in the litter and organic matter of the upper soil layers in different types of arctic ecosystems averages from 40 to 70 t/hectare and considerably exceeds its reserve in the phytomass. In addition, the permafrost layer in some regions contains great quantities of fossil carbon. The anticipated climatic warming could quite rapidly change the thawing and freezing regimes of tundra soils and substantially activate biogenous oxidative processes. Some parameters of the carbon budget for the tundra and wooded tundra of Russia were found by generalization of empirical materials in the literature and an original computer-generated map of the landscapes of Russia, with the tundra zone broken down into a number of regions. The mean reserves of phytomass and primary production were computed for each landscape (nine regions). The area of the tundra and wooded tundra zones of Russia is 283.5 million hectares, 16.6% of the total area of Russia and 32% of the world tundra biome. The carbon reserve in the living phytomass of tundra and wooded tundra and wooded steppe ecosystems of Russia is 2.73 Gt, or 34.2% of the world reserves of carbon in the living phytomass of this biome. The data obtained were consistent with those in the world literature, although the methods used in such earlier studies were flawed. Figure 1; references 6: 2 Russian, 4 Western.

Photosynthesis and Change in Atmospheric CO_2 Content

957N0008C Moscow PRIRODA in Russian
No 7, Jul 94 pp 25-27

[Article by A.T. Mokronosov, academician, director, Plant Physiology Institute imeni K.A. Timiryazev, Russian Academy of Sciences, chief editor, FIZIOLOGIYA RASTENIY]

[FBIS Abstract] The storage of atmospheric carbon in the photosynthesis process has been computed by different methods, but each of them has its shortcomings. As an alternative, the author proposes a new method for estimating the productivity of photosynthesis: the chlorophyll method. There is a high linear correlation (0.8) between the chlorophyll index and the annual bonding of atmospheric carbon both in model phytocoenoses and in natural associations in different botanic-geographic zones. The annual chlorophyll productivity in different types of vegetation associations varies from 150 to 300 kg of carbon per 1 kg of pigment. Mean photosynthetic productivity was computed from the uptake of carbon in areas occupied by different types of plant formation, which is 4.4 Gt C/year. A doubling of the CO_2 concentration will exert an influence on the productivity of the leading agricultural crops. For grains, potatoes and beets the increase would be 20-30%, whereas for corn, sorghum and millet there would be only an insignificant increase. In order to store and use analytic information on photosynthetic productivity two program packages have been prepared for use in the analysis and prediction of the uptake of carbon, calculation of its balance for biological purposes, for determining the yield of agricultural crops, changes in the ranges of occurrence of species due to climatic change and under the influence of anthropogenic impact. Such a bank of photosynthetic characteristics of types of phytocoenoses of the principal plant formations, collected during the last 30-40 years, is a necessary tool for solving analytic and predictive tasks facing researchers working under the "Global Climatic Changes" program. Figures 2.

Model of Global Carbon Cycle

957N0008D Moscow PRIRODA in Russian
No 7, Jul 94 pp 27-32

[Article by A.M. Tarko, doctor of physical and mathematical sciences, senior scientific specialist, Computer Center, Russian Academy of Sciences]

[FBIS Abstract] A spatially distributed mathematical model of the global carbon cycle was constructed for the atmosphere-plants-soil-ocean system and was used in determining the parameters of the CO_2 cycle for Russia and other countries with allowance for the anthropogenic impact. In the model the entire territory of the planet is divided into grid units measuring 4 x 5° in a geographic system. Each grid unit on the land is assigned to one of 30 types of ecosystems. The model is described by a system of about 1500 ordinary nonlinear differential equations; its variables are the quantity of carbon in the biomass of living plants, in humus in each land grid unit, and in the atmosphere. In the model the annual production of plants is dependent on the CO_2 concentration in the atmosphere, temperature and precipitation in a given grid unit; the quantity of humus in a stationary state and the specific intensity of the decomposition of humus are dependent on temperature and precipitation. A point model was used for describing the carbon cycle in the atmosphere-ocean system. Biospheric dynamics was simulated for the period 1860-2025. Table 1 gives the change in carbon quantity in reservoirs of eleven different countries separately for 1860-1988 and 1989-2025. The model was used in preparing

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Table 2—change in carbon content in reservoirs of temperate zone forests of different countries and Table 4—change in content of carbon and its flows in 16 different types of Russian ecosystems during 1860-1988. Figures 2.

Transformation of Organic Matter in Humus

957N0008E Moscow PRIRODA in Russian
No 7, Jul 94 pp 32-36

[Article by D.S. Orlov, doctor of biological sciences, professor, head, Soil Chemistry Department, Soil Science Faculty, Moscow State University imeni M. V. Lomonosov]

[FBIS Abstract] Only an approximate estimate can be made of humus (organic carbon) reserves. Most organic carbon is in zones of adequate or excess moistening—210.9 Gt; steppe, dry steppe and semidesert soils account for only 25.3 Gt, or 9.5% of the reserves in the soils of all Russia. This means that 89-92% of all carbon reserves are almost not dependent on moisture content changes; the key factor is the temperature change. A table gives the reserves of organic carbon in the layer 0-100 cm of Russian soils and peats. Thirty-nine percent of all these reserves are in peaty-swampy soils and peat bogs and in such areas the organic mass is continuously increasing. The cultivated soils of Russia, where the greatest humus losses are occurring, contain only 9.2% of all soil organic matter. Another significant reserve of dead organic matter is the litter in tundra and forest ecosystems where the total carbon reserves are estimated at about 10 Gt (tundra—3 Gt, forest—7 Gt). Warming in the tundra may lead to peat accumulation and an uptake of carbon into the soil. The annual humus losses vary from 1.5 to 3 t/hectare. If such losses are inevitable and constant, already by 2025-2050 many soils will remain without humus. But such predictions are erroneous because rapid (up to 30%) humus losses are possible only when plowing virgin lands, but some researchers assign such a level to all cultivated soils; moreover, during the last 100 years use has been made of noncomparable and not always precise methods, leading to false conclusions. In actuality, when cultivation practices remain unchanged the humus content is stabilized at some level. Humus losses are not necessarily accompanied by carbon dioxide emission into the atmosphere. All possible prediction variants indicate that a climatic warming would cause uptake of carbon from the atmosphere into the soils of humid landscapes and release of carbon dioxide into the atmosphere from the soils of arid regions. Since humid areas predominate for Russia, for the country as a whole there should be a positive balance of organic carbon in the soils. Figure 1.

Carbon Dioxide Release by Soil Cover in Russia

957N0008F Moscow PRIRODA in Russian
No 7, Jul 94 pp 37-43

[Article by V. N. Kudeyarov, doctor of biological sciences, professor, head of nitrogen and carbon soil cycles laboratory, Soil Science and Photosynthesis Institute, Russian Academy of Sciences, Pushchino]

[FBIS Abstract] The production of carbon dioxide is one of the most important functions of the soil since the mineral of organic matter in the soils supplies plants with CO_2. Soil breathing includes the breathing of plant roots and soil organisms (bacteria, fungi, soil animals). Various methods are used in estimating soil breathing, but all give similar results and therefore findings obtained using the different methods were generalized. Soil breathing is dependent on its temperature, moisture content, mechanical composition and chemical properties, as well as its receipts of pesticides, fertilizers and various organic materials. The intensity of soil breathing is dependent on the qualitative composition of the carbon sources, one of which is humus, but the activity of microorganisms active in the decomposition of organic matter is highly important. Judging from the dynamics of carbon dioxide release by soils, in most cases the duration of CO_2 emission coincides with the duration of the frost-free or growing season. Most CO_2 is released during the growing season, but the soil begins to breathe immediately after thawing and continues up frosts. Winter emission has been studied poorly but does not exceed 1-2% of the annual CO_2 production. A change in land use may either increase the CO_2 uptake or reduce it, with an increase in emission. Reforestation results in carbon being stored for a long time in the wood of growing trees. It is estimated that CO_2 emission by the soil cover within the present boundaries of Russia is 1.84 Gt C/year. Using a CO_2 soil emission databank, knowing the areas of soil units and the duration of the growing season for different soil-climatic zones, it was possible to compute the total quantity of CO_2 soil emission for Russia. The CO_2 release is 3.12 Gt C/year. The poorest data on soil breathing are for the tundra zone. The data obtained in the study are approximate but fill a significant gap in the estimate of the total carbon dioxide budget for Russia. Figure 1; references 7: 6 Russian, 1 Western.

Biospheric Importance of Swamps in Carbon Cycle

957N0008G Moscow PRIRODA in Russian
No 7, Jul 94 pp 44-50

[Article by S.E. Vomperskiy, corresponding member, Russian Academy of Sciences, director, Forest Management Institute, Russian Academy of Sciences, head, forest swamp science and hydrology laboratory]

[FBIS Abstract] The biospheric role of Russian swamps is evaluated. Such an evaluation is handicapped because information on the areas of swamps of different nature is inadequate and contradictory and in various regions the depth of peat deposits and the carbon reserve in them have not been estimated. A table was prepared giving the area of Russian lands characterized by peat formation and the carbon reserves in peats. The total area of such lands is 21.6% of the area of the country, most (84%) of these lands being in the Asiatic part of the country. There are about 113.5 Gt of organic carbon of biota in the peats of swamps and swampy soils, approximately half the carbon reserve in all nonswampy soils, but considerably more than in the phytomass of Russian forests (41.2 Gt). World estimates of

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the hydrocarbon pool of swamps vary, but not less than one-third is in Russia. It is important to consider the consequences of economic exploitation of swamps, especially the commercial working of peat, which causes the rapid emission of the carbon which it contains. Steps must be taken to preserve the carbon-accumulating functions of swamps. Careful study must be made of the response of swamps to the warming of climate and a change in moistening. In particular, changes in swamp formation in permafrost areas are unpredictable. The uncertainty in the consequences of exploitation of swamps limits the reliability in determining the total carbon budget of Russian swamps. Figures 4; references 9: 3 Russian, 6 Western.

Carbon Cycle in Natural Ecosystems of Russia

957N0007A Moscow PRIRODA in Russian
No 7, Jul 94 pp 15-18

[Article by G. A. Zavarzin, professor, corresponding member, Russian Academy of Sciences, head of lithotrophic organisms laboratory, Microbiology Institute, Russian Academy of Sciences; the first paragraph is an introduction]

[FBIS Text] At the UN World Conference on the Environment and Development, held in the summer of 1992 in Rio de Janeiro, among the most important ecologic agreements signed was a Convention on Climatic Change. The countries signing it assumed definite obligations, such as evaluation of the sources of greenhouse gases, as well as study of the natural mechanisms of their accumulation and elimination, that is. sinks and reservoirs. In Russia this problem is being solved within the framework of the state scientific and technical program "Global Changes in the Environment and Climate" under the direction of Academician N. P. Laverov. In November of last year, at a conference on the "Carbon Budget in Russia," there was discussion of some results of the work of the research teams working under this program. The results presented at the conference made it possible to determine the priorities in study of ecosystems and the specific biological mechanisms participating in the carbon cycle in Russia. We present the reader with materials from this conference.

According to available predictions, by the middle of the 21st century it is expected that the mean global temperature will increase by 1°C, which may result in a change in climate and restructuring of the biota. Such a prediction is related primarily to an intensification of the greenhouse effect caused by man's economic activity and governed, in particular, by disruption of the carbon dioxide budget. Today the percentage of anthropogenic carbon dioxide in the greenhouse effect is estimated at 61%, that of methane—23% and that of nitrous oxide—4%, whereas the rest is accounted for by other microimpurities. It is anticipated that by the years 2050-2070 the atmospheric CO_2 concentration will double in comparison with the preindustrial epoch. The positive or negative effect of such changes for the economy, especially agriculture, forestry and water management, may be different for individual regions of Northern Eurasia. Since the principal role in the greenhouse effect is played by CO_2, an estimate of the natural flows of this component is a priority task, which today is being undertaken by researchers in different countries.

Russia occupies a special place in the global climatic system due to its unique absorbers (sinks) and accumulators (reservoirs) of greenhouse gases. This circumstance determines the importance of the work carried out by participants in the state program "Global Climatic Changes" because the destruction of absorbers and accumulators of greenhouse gases may exert a considerable influence on the carbon cycle in Russian ecosystems.

The requirement for "protecting and enhancing the quality of their absorbers and accumulators of greenhouse gases," imposed under the climatic convention, applies, in particular, to the natural ecosystems which are under a national jurisdiction. Thus, in terms of sources, sinks and reservoirs of greenhouse gases it is primarily anthropogenic sources and natural sinks which are considered. The situation is substantially different for countries with a limited area and a well- developed industry and countries with an extensive area: whereas for the first the sole way for establishing a favorable balance of greenhouse gases is the restriction of release, for the second there is a possibility for retaining and increasing the capacity of the natural absorbers and accumulators of greenhouse gases.

According to data from the intergovernmental group of experts (IPCC) and the results of individual studies, the annual world anthropogenic CO_2 release is 5.6 Gt, or about 10% of the cycling of carbon in surface ecosystems. Approximately half this release is detected in the atmosphere and about 2.5 Gt constitute an "unknown sink" which may be either the ocean or surface ecosystems. The annual release of CO_2 by Russian industry is estimated at 0.65-0.7 Gt, of which 0.327 Gt is attributable to fuel and power enterprises. In Russia the industrial release of CO_2 was 11% of the world total (for comparison: United States—22%, China—10%).

The functions of surface ecosystems as sources or sinks of CO_2 are determined by the balance between the photosynthetic production of organic carbon (C_{org}) and the release of CO_2 during the respiration and decomposition of organic matter. If organic carbon is accumulated in the ecosystem over a prolonged time, this shows that this ecosystem serves as a carbon dioxide sink. Since the CO_2/O_2 ratio for photosynthesis and respiration is close to 1 it can be asserted that ecosystems with a high content of organic carbon both in the living biomass and in the stable organic matter of the soil served not only as a global carbon dioxide sink, but as a global source of atmospheric oxygen. The excess oxygen entering the atmosphere is equivalent to the fossil carbon. With respect to the content of stable C_{org}, soils per unit area of the Russian ecosystem fall into the following series: swamps, steppes, forests. Organic carbon is accumulated primarily on the plains, whereas the mountain regions are poor in it, and Northern Eurasia, and especially Russia, is the most extensive plain

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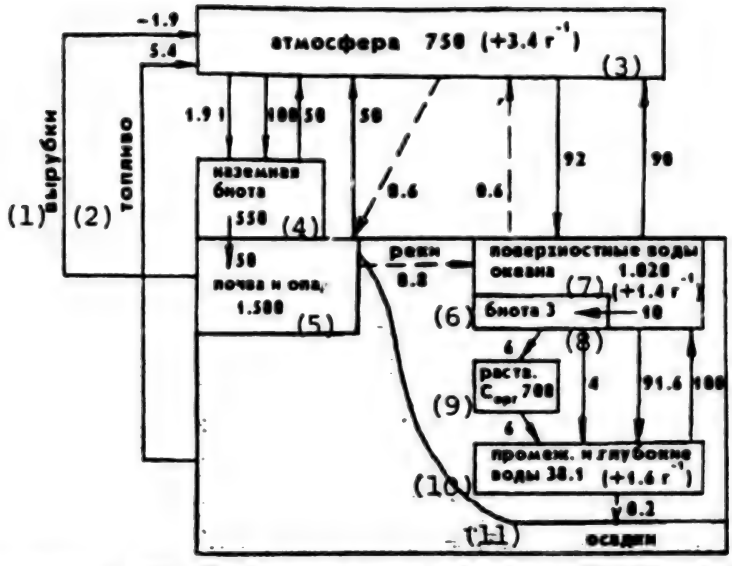

Global carbon cycle during period 1980-1989. The principal oxygen reservoirs (in Gt) are indicated in the frames, the principal flows (in Gt/year) are indicated on the arrows. The dashed arrows designate the difference between river transport and accumulation of sediments, compensated by flows from the ocean into the atmosphere and from the atmosphere into the biota (from: U. Siegenthaler and J. L. Sarmiento, NATURE, Vol 365, p 119, 1993].

Key: 1. forest cuttings 2. fuel 3. atmosphere 4. surface biota 5. soil and leaf fall 6. rivers 7. surface waters of ocean 8. biota 9. dissolved C_{org} 10. intermediate and deep waters 11. sediments

in the world. The total content of C_{org} in the soils and peats of Russia is 296.1 Gt, of which 80% is accounted for by plains areas.

The variations in the atmospheric CO_2 concentration in the northern hemisphere are essentially dependent on the seasons and their amplitude decreases equatorward. This is attributable to the fact that the ecosystems of the boreal zone absorb CO_2 only during summer. Such a mechanism determines the role of the ecosystems of the moistened belt of the northern hemisphere (Russia, Canada, Scandinavia) in regulating the atmospheric CO_2 content. However, these seasonal variations are absent in the southern (oceanic) hemisphere.

Theoretically atmospheric CO_2 variations can be used in determining its inflow. The carbon sink is estimated from the difference between its absorption during photosynthesis by green plants and its release during the breathing of heterotrophic organisms.

It has been calculated for Russia that green plants absorb 4.4 Gt of carbon annually. This estimate was obtained by essentially different methods. The CO_2 decrease during photosynthesis is determined gasometrically (nonintegral estimate). The annual production of photosynthesis is calculated from the accumulation of biomass during the growing season (integral estimate). Most of the data have been obtained precisely by this method, precluding the errors associated with plant respiration. Photosynthesis production also is estimated from the chlorophyll index, that is, from the ratio of assimilated carbon to the chlorophyll content per leaf area and the surface covered by this vegetation. The advantage of such an approach is the possibility of using aerospace methods. It is most difficult to extrapolate data to the areas of the corresponding associations, that is, to overcome classification and cartographic difficulties (see article by A. T. Mokronosov).

The calculation of CO_2 release by heterotrophic organisms is the opposite problem. The principal CO_2 source is soil breathing, including the breathing of the roots, microorganisms (fungi and bacteria) and soil animals. On the basis of available data for Russia a map of gradations of CO_2 emission from the soil was prepared for the first time and the total emission—3.12 Gt of carbon annually due to soil breathing—was determined. These calculations indicate that the breathing of the soil, exceeding industrial emission in Russia by a factor of 4.5, is the most intense CO_2 source in the territory of the country (see article by V. N. Kudeyarov).

The difference between the computed levels of formation of organic carbon and the release of CO_2 in Russia is about 1 Gt/year. This indicates incompleteness of allowance for natural sources. In estimating CO_2 release no allowance was made for the respiration of surface biota, especially the decomposition of wood by fungi (the breathing of ground animals accounts for not more than 5%). Some of the CO_2 is removed from the cycle at different times and is stored in the reservoirs.

In forest systems carbon can be stored in newly formed wood. In computations made using statistical data on the

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forest resources of the country the increase in tree stand biomass was used as the wood increment. The total sink of carbon in forest systems is 200 MtC/year. This quantity is much less than most foreign estimates (400 MtC/year). It is evident that to a high degree "the conducting of a national policy and the adoption of appropriate measures for alleviating the consequences of climatic change by means of restrictions on our anthropogenic release of greenhouse gases and protection and increasing the quality of our absorbers and accumulators of greenhouse gases" (Article 4.2a of the Convention) corresponds to the struggle against forest fires. This is especially important for our country due to the increasing frequency of fires, easily determined from space. Forest fires may account for up to ¼ of the industrial release (see article by A. S. Isayev).

An indisputable carbon dioxide sink for Russia is peat formation in swamps, amounting to 40 Mt of carbon annually; with allowance for lands with dispersed peat formation this figure increases (see article by S. E. Vomperskiy). When estimating the carbon sink in swampy systems no allowance is made for the carbon stored in the plant mass over the peat layer because in comparison with the peat mass its quantity is insignificant, although the time of its presence is comparable to the time of its presence in wood.

In the living phytomass of the Russian tundra, constituting about ⅓ the total world tundra area (283.5 million hectares), there are 2.7 Gt of carbon and its annual production is estimated at 400 MtC/year in living biomass. Thus, the tundra zone can serve as a carbon dioxide sink (see article by D. G. Zamolodchikov).

It is impossible to make a reliable estimate of the dynamics of the stability of soil carbon because it is in this reservoir for hundreds of years. However, the organic carbon of the soil serves as an integral evaluation of the ecosystem function as a producer of O_2 because atmospheric oxygen corresponds to the conserved organic carbon. A replacement of the agrophytocoenoses of the steppe and wooded steppe biocoenoses, natural accumulators of organic carbon, must be regarded as a highly important global factor impairing the carbon budget.

The cited data convincingly demonstrate the need for estimating the sinks and reservoirs of carbon from the mass of annual entry of carbon dioxide and the time of its presence in the reservoir. In the territory of Russia there are ecosystems with carbon dioxide removal which is nonreturnable within the limits of the considered time.

It also is possible to estimate the cycling of carbon for Russia by using mathematical simulation methods with a system of about 1500 ordinary nonlinear differential equations. Calculations have indicated that in the territories of all the selected countries during the period 1860-1988 carbon dioxide was absorbed and especially actively by temperate zone forests. Canada, where carbon dioxide was absorbed more strongly than it was released in industrial effluent, is in the best situation. The tropical countries—India, Brazil and Australia—are a CO_2 source. According to this model, the territory of Russia as a whole can be regarded as a CO_2 sink. It is important that the results indicate the role of Russia and the other countries of the moistened belt of the northern hemisphere as "light planets." The same conclusion can be drawn from an analysis of the carbon cycle in the territory of Russia both on the basis of budget calculations, from the total index of accumulation of organic carbon as a result of the production-destruction imbalance, and also on the basis of the indicator of accumulation of dead organic carbon in the ecosystems of the moistened belt of Northern Eurasia. Thus, the territory of Russia is one of the most important CO_2 sinks in surface systems.

The Concept of Evaluating Ecological Risk

957N0001B Moscow GEOEKOLOGIYA in Russian
No 4, Jul-Aug 94 (manuscript received 3 Jun 93) pp 20-24

[Article by V. V. Gavrilov, N. N. Romanovskiy, D. O. Sergeyev, I. A. Utkina, Ekologiya FTsGS [expansion not given]; UDC 624.131]

[Annotation] It is shown that one can develop approaches to the evaluation of ecological risk by formalizing the procedure for constructing a conceptual information model in a class of ecosystems. The main system-forming factor in these ecosystems is geo-ecological processes. The ecological risk of engineering and economic activity for a specific natural-technical system is evaluated using quality of life indicators (public health, medical and biological, and socioeconomic) for each set of ecological problems.

[FBIS Translated Text] The concept of ecological risk is used scientifically and practically to evaluate the technological risk of an unforeseen unfavorable effect on the environment and the possibility of unfavorable ecological situations arising as a result of use of the environment.

The problem of evaluating ecological risk has long been the subject of research.[2,3]

The multitude of definitions of ecological risk leads to ambiguity in existing standards documents regulating the use of the environment. For example, the concept of ecological risk is used in the procedure of State Ecological Certification of environmental use sites as the equivalent of evaluation of the effect on the environment, and this is ineffective.

The goal of this paper is to develop approaches to the evaluation of ecological risk as the probability of unfavorable (extraordinary) ecological situations arising. An unfavorable ecological situation is understood to mean a set of events or phenomena reflecting a worsening of the quality of the environment, which is defined as the correlation of natural conditions to the needs of living organisms. A worsening of the quality of the environment causes negative ecological, social, and economic consequences which are expressed as: a worsen ing of the conditions of life or a loss of life of humans; destruction of the structure or functioning of ecosystems; or socioeconomic decline borne by the economy as a result of a change in the characteristics of natural-technical systems.

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Unfavorable ecological situations arise as a result of development of natural processes (earthquakes, mudslides, floods, avalanches, landslides, rockslides, etc.); natural processes of technogenic origin (pollution of ground water, technogenic earthquakes and landslides, destruction of the soil and landscape, etc.); and technological emergencies which drastically change the parameters of technogenic effects on the environment.

Unfavorable ecological situations are subdivided into natural, natural-technogenic, technological, and mixed origin.

Depending on the scale of development of changes in (worsening of) the quality of the environment, the unfavorable ecological situation may be considered: 1) objective (worsening of the quality of the environment develops in the area of land removal at an environmental use site); 2) local (the situation encompasses several use sites, but has a limited territorial area, up to tens, or more rarely, hundreds of square kilometers); 3) regional (encompassing large territories comparable with the drainage basins of large rivers or large administrative-territorial units); 4) situations at the federal level (developing on the scale of countries or affecting the interests of several subjects of a federation).

Ecological risk is the probability of an unfavorable ecological situation arising. Ecological risk has the following properties: 1) variability over time (associated with the change in the state of the natural-technical system); 2) variability over space (due to the variability of natural conditions and various forms of human economic activity); 3) "acceptability" of ecological risk (depending on the significance of ecological and socioeconomic events caused by an unfavorable ecological situation and defining a set of regulating organizational, legal, and technical solutions to improve the quality of the environment).

Methodological foundations of evaluation of ecological risk.

It is expedient to evaluate ecological risk using human quality of life indicators, which are the correlation of natural conditions to the needs of man. The evaluation of ecological risk includes several stages and may be represented by a flow chart of the formalized evaluation procedure (see figure).

The main goal of this paper is to formalize the procedure for constructing a conceptual information model in a class of ecosystems. The main system-forming factor in these ecosystems is geo-ecological processes.

The geological environment is in many cases the bearer of the main driving forces determining the generation of

Figure. Stages of evaluating ecological risk.

Key: a. evaluation of ecological risk; b. public health; c. medical and biological; d. socioeconomic; e. human quality of life indicators; f. concept of an information model of a natural-technical system; g. existing and possible ecological problems and situations; h. evaluation of ecological risk (primary); i. conceptual information model of a natural-technical system (primary); j. characteristics of a geological environment (geotype); k. characteristics of other environments (air, water, biosphere); l. characteristics of technogenic activity (technotype).

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unfavorable ecological situations. The parameters of the geological environment are at the very beginning of the chain of cause and effect.

These parameters are defined by natural factors and biogeocenosis of the conditions of human existence.

In order to evaluate ecological risk in the territory of the Russian Federation, one should divide it into regions which have similar geological-geographical, climatic and other conditions (for example, Western Siberia, the Urals, the Arctic islands, etc.). For each region one should construct (or use an existing) typing of the environment. This typing is based on typing of the ecological environment. The latter is a division of the types of geological environments (geotypes) according to a number of parameters.

These parameters reflect the composition, structure, and state of the main components of the geological environment: rock, ground water, geological processes, etc. The main parameters determining the geo-ecological state of the environment or those which are indicative of ecological disruption are selected. A corresponding complex of characteristics of other natural environments is constructed for each type of geological environment (geotype).

Based on typing of the environment, one can construct classification series of environmental types using a set of natural indicators which cause differing degrees of worsening of human quality of life or the quality of the environment as a result of the development of negative natural processes. Among the latter are processes which cause natural disasters (earthquakes, mudslides, landslides, floods, hurricanes, etc.) and slow negative processes (desertification, bog formation, salination of the soil, agradation and degradation of permafrost, etc.).

At the same time that one classifies types of environment, one should systemize types of engineering-economic operations and activity by the following criteria: 1) degree of danger of engineering-economic activity to the environment; 2) degree of liability of the operations and probability of technological catastrophes; 3) indicators of the environmental use site according to the ecological certification (GOST 17.0.0.04-90).[1]

The combination of the aforementioned parameters characterizing the environmental use site as a part of a natural-technical system, is defined as a "technotype". For each technotype one evaluates possible technogenic loads and corresponding effects on the environment. Classification series of types of economic activity are compiled on the basis of the technotype using a set of technogenic effects causing various degrees of worsening of the quality of human life or the quality of the environment.

At this stage it is expedient to create a primary information conceptual model for the natural-technical system containing data on the characteristics of the environment and technogenic loads.

Based on the developed classification series for the environment and types of economic activity, one compiles a matrix system for the natural-technical system models. The position of the model in the matrix reflects the value of the ecological risk of engineering-economic activity. The classification scale for the environment makes it possible to place a conceptual model of the natural-technical system in the matrix in accordance with the probability of naturally-generated unfavorable or extreme ecological situations or catastrophes arising. The classification scale of types of economic activity defines the place of the conceptual model of the natural-technical system according to the probability of natural and natural-technogenic unfavorable or extreme ecological situations or catastrophes arising.

This system does not reflect possible ecological problems and situations, so it can be used to evaluate the value of the ecological risk for a specific natural-technical system on a qualitative level, without considering remote or indirect consequences of a technical origin. However, in a number of cases this type of simplified approximate evaluation, which lends itself to formalization, it necessary.

Obtaining a quantitative evaluation of the ecological risk using the indicators of human quality of life for a specific natural-technical system is the next stage of work. In this stage one compiles a catalog of existing and hypothetical ecological problems at the local and regional level considering the probability of technological accidents. This catalog makes it possible to divide the characteristic set of ecological problems for each type of environment considering the differing character of economic activities. Moreover, this catalog is supplemented with existing and predicted ecological problems of the real existing natural-technical system.

The catalog of ecological problems individually examines groups (packets) of problems with differing degrees of acceptability of ecological risk. The criteria for dividing these groups requires special development and validation; however, it is obvious that there will be a set of packets of problems where the ecological risk is UNACCEPTABLE due to the high probability of an unfavorable ecological situation arising or because of the high cost of possible losses, even for a low probability of a negative development of events. The unacceptability of ecological risk should be a signal to halt activity until the factors causing the ecological risk to be unacceptable are removed. There will also be a group of packet s of problems whose ecological risk will be characterized as ACCEPTABLE, that is, the activity is permitted with some corrections which reduce the ecological risk to the INSIGNIFICANT level.

The examination of packets of ecological problems makes it possible to create a more complete information conceptual model of a natural-technical system, which in addition to parametric environmental and technogenic characteristics should be characterized by: 1) a packet of existing ecological problems, and 2) packets of possible ecological problems composed in accordance with various scenarios for the development of an ecological situation, developed by experts by or with the aid of predictive modeling.

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Evaluation of the ecological risk of engineering-economic activity for a specific natural-technical system is performed using indicators of human quality of life (public health, medical and biological, and socioeconomic) for each packet of ecological problems and for various combinations of these packets in accordance with hypothetical scenarios for the development of an ecological situation, with a consideration of the probability of technological accidents. In the latter case the evaluation of ecological risk will differ depending on the depth of the prediction.

Thus, the procedure for constructing a conceptual model of a natural-technical system to evaluate ecological risk can be formalized and consists of two stages: creation of a primary model of the natural-technical system which reflects the environment and technogenic loads; and creation of a complete model of the natural-technical system including a primary model and the result of interaction of the environment and technogenic effects in the form of ecological problems an d situations.

The accuracy of the evaluation of ecological risk depends on the scale of the natural-technical system examined, how complete the information is in the model of the natural-technical system (ecosystem), the complexity of technogenic effects, and the duration and intensity of development of the natural-technical system.

It must be noted that existing zones with extreme ecological situations require a special approach to the evaluation of ecological risk.

Conclusions

The degree of ecological risk is an indicator of the need to take action to prevent extreme ecological situations. The strategy of prompt measures to prevent unfavorable and catastrophic ecological situations in regions of ecological risk will depend on a set of regional ecological problems and the general federal economic situation, and includes a set of geotechnical, economic, legal, and organizational decisions.

The creation of a standard method to evaluate ecological risk requires further development in the following areas:

1. Scientific and methodological:

   classification of environmental types and technogenic effects, cataloging and systemization of ecological problems.

2. Organizational and legal: creation and use of the State System of Ecological Monitoring;

   optimization the operation of the State Service of Ecological Monitoring;

   optimization of the operation of the State Ecological Certification program.

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Consequences of Technogenic Destabilization of the Depths of the Astrakhan Gas Condensate Deposit in the Underground Nuclear Explosion Zone

957N0001B Moscow GEOEKOLOGIYA in Russian
No 4, Jul-Aug 94 (manuscript received 20 Sep 93) pp 25-42

[Article by B. N. Golubov, Scientific Council on Problems of the Biosphere, Russian Academy of Sciences; UDC 622.2:624.131.1:623.451.8(471.46)]

[Annotation] Technogenic destabilization of the natural complexes of the Lower Volga region has increased sharply since the Astrakhan gas condensate deposit was discovered in 1973 and since fifteen underground nuclear explosions were set off in 1980-1984 to construct storage facilities for the gas condensate in a salt-bearing stratum. Despite calculations, the cavities formed by the underground nuclear explosions soon rapidly deformed and filled with water. Radioactive brine began to be forced to the surface from these cavities. This situation complicates the problem of insuring ecological safety, reliable operation of the gas chemical complex, and maintenance of the resource potential of the Astrakhan gas condensate deposit, and is being exacerbated by a rise in the ground water level in the region due to an anomalous increase in the level of the Caspian Sea, which began in 1978.

[FBIS Translated Text] Until the mid 1970's, the stability of the environmental systems of the Lower Volga region was evaluated mainly in relation to the regulated flow of the Volga. Implemented in stages (since 1942 and 1958) it changed the course of exogenic geological processes, destroying the established mode of floods, sediment discharge, salt accumulation in soil, etc. This was rapidly succeeded by noticeable shifts in the biosphere, noted by the residents of the Astrakhan reserve and other regions.[2,10,13,14,21,27] After work began at the Astrakhan gas condensate deposit (AGCD) and the first line of the Astrakhan gas refining plant (AGRP) went into operation, the strong effect of technogenesis encompassed the water, atmosphere, and the depths of the earth. The dangerous effect of the AGRP on the atmosphere is rather well known; it was specially noted in two summary conclusions of the State Ecological Evaluation of the State Committee on the Environment of the RSFSR in its plan for the second line of the Astrakhan gas complex dated 15 Feb 1989 and 2 Jun 1989. It was also noted in a resolution of the Council on State Ecological Evaluation of the State Committee on the Environment of the RSFSR dated 9 Mar 1989 (No 11-2/1-88), which postponed the plan to

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expand the complex until the ecological situation around the first line of the AGRP was normalized.

Little is known about the technogenic destabilization of the depths of the earth in the region. There have been two main stages in its development. In the first stage (up to the discovery of the AGCD in 1973) the effects of technogenic disturbance of the depths were relatively small, and it is probably for this reason that they were not considered. In the second stage (after 1973) the technogenic effect on the depths increased sharply, especially after the creation of storage facilities for gas condensate in a salt-bearing stratum in 1980-1984 by way of fifteen underground nuclear explosions. But these operations, which bore the code name Vega, remained secret for a long time, and could not even be considered, although their effect was rapidly noted through indirect indications.

The purpose of this paper is to determine the reasons for the increasing destabilization of the depths of the region and it consequences, especially during the second stage. This stage is unique because, first, the Astrakhan gas and chemical complex, which unites the AGCD, the AGRP, and the underground storage facilities, began to notice shifts in not only exogenic, but also endogenic geological processes, in the form of sudden shifts of the rock massif, a dramatic activation of fluid dynamic flows, etc. Second, this time coincided with an anomalous rise in the level of the Caspian Sea, which began in 1978, and with flooding of vast areas of the Lower Volga, including the underground nuclear explosion zone. Third, these shifts have already created an emergency situation and have exacerbated the problem of insuring the ecological safety of the region, the reliable operation of the entire gas and chemical complex, and preservation of the resource potential of the AGCD.

Geological Profile of the AGCD Region

In 1973, 60 km north of the city of Astrakhan, the first flow of gas from limestones of the viseite stage of the Carboniferous system came from the Zavolzhskaya-3 well from a depth of 4260-4304 m. Three years later, well Shiryayevskaya-5 yielded the first commercial gush of gas with condensate, which announced the discovery of the AGCD and confirmed predictions of the presence of a new level of gas and oil content in the subsalt structural level of the lateral zone of the Caspian syncline, a large tectonic element of the ancient East European platform with three structural levels to its profile: the subsalt level, the salt level, and the supersalt level.

The AGCD is located on both shores of the Volg a-Akhtubinsk floodplain in the Upper Khvalyn sea plain, composed of sand hills, erosion rills, channels and lakes. The largest lakes are Karasor lake (18 hectares) and Aydyk Lake (6.2 hectares). The depth of erosion cuts reaches 30-32 m at the Volga and 20 m in smaller tributaries. The area of the AGCD is 4000 km^2. Today, the left bank section of the deposit, with an area of about 200 km^2, is being used. This section is 50 km north of the city of Astrakhan.

The AGCD is confined to a protrusion of a foundation of sublatitudinal orientation 160x120 km in size. The elevated part of the surface of the foundation lies at a depth of about 8.0 km, and the lower part of the foundation surface lies at a depth of 14-18 km. The protrusion is comprised of faults with an amplitude of 2 to 10 km. In the subsalt layer this protrusion corresponds to the Astrakhan arch, 110x50 km in size, contoured by the roof of limestones of the Bashkir stage at depths from 3900 to 4400 m. The salt level is comprised of coastal facies of a halogenic stratum of the Kungur stage and forms a number of salt domes grouped in four ridges of northeast strike with a width of up to 6 km. The most complex in structure is the southeast Aksara ysko-Utigenskaya ridge (Fig. 1), which has steep fractured sides and is composed of a geniculate flexure. In this flexure (where 13 underground nuclear explosion cavities are concentrated) are two structural sublevels distinguished by the behavior of the structure contour of the roof of salt-bearing sediments below and above 1000 m. These sublevels are the upper and lower sublevels, probably separated by a sharp azimuthal nonconformity, which may be due to diapirism within the salt. The lower part of the structural level above the salt is composed of a Pre-Pliocene complex of sediments, which as a whole inherits the configuration of the Astrakhan arch. It is comprised of local brachyaxial folds and outbursts of salt domes. Their active growth occurred in the Triassic, Pre-Jurassic, Pre-Cretaceous and Pre-Akchagyl. The overlying Pliocene-Quaternary complex of rock with sharp angular and azimuthal nonconformity lies at more ancient strata of different ages, and the arches of individual domes are directly intersected by the salt structural layer, forming a number of depressions and elevations of submeridional orientation. These depressions are confined to the Pre-Akchagyl and are erosional-tectonic in nature. Above them are several generations of younger Quaternary paleovallies filled with alluvial gravels and sands. The Pre-Khazar valley in the region of the AGCD has a width of 30-35 km and is separated into a number of branches. The absolute indicators of its floor reach 128 m, and the depth of the downcutting reaches 80 m [Ref. 33].

The sharp angular and azimuthal nonconformity at the Pliocene base indicates that in the Post-Ponticheskoye period, due to the separation of the superposed tectonic basins of the Caspian Sea, the previously formed structures were subjected to drastic deformation, which has not yet ended. Indications of this have been recorded in geomorphological and geodesic observations, as well as in anomalies of fluid dynamic and geothermal behavior of the depths of the earth. In particular, repeated geodesic observations made by V.A. Sidorov showed that in the lateral zone of the Caspian basin the intensity of current tectonic movements changes abruptly in the space of 1.5-2.0 km at the boundaries of narrow linear blocks. Since the second half of 1977, the values of the gradients of movement have risen by a factor of 2-3, and this coincided with the beginning of an anomalous elevation of the level of the Caspian Sea.

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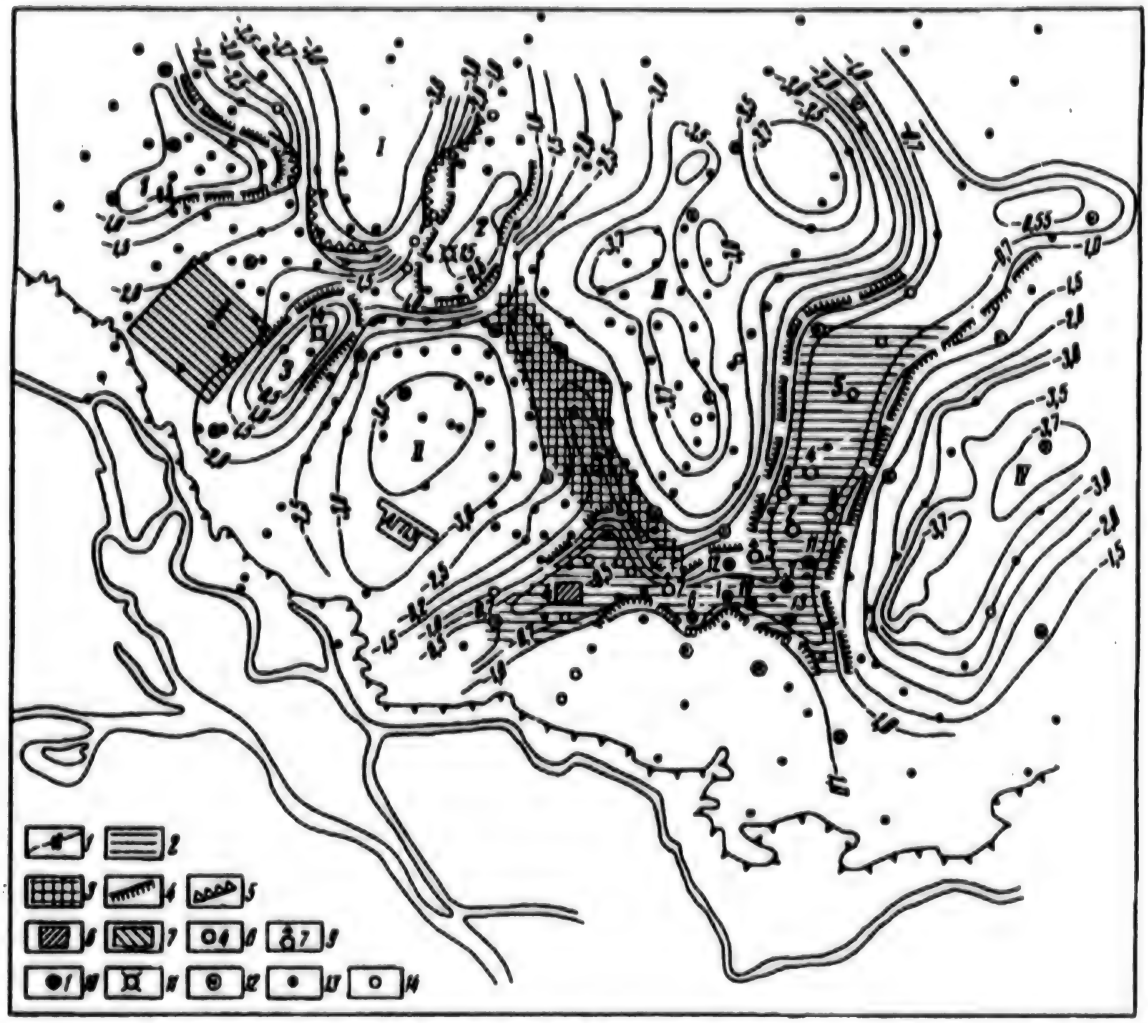

Figure 1. Structural schematic of the left bank of the Astrakhan gas condensate deposit along the roof of the salt-bearing stratum of the Kungur stage.

Key: Salt structural stage: 1. structure contours of the roof of the Kungur stage, m; 2. upper sublevel; 3. lower sublevel; 4. flexures and fractures of the steep sides of salt ridges; 5. thrusts of mushroom-shaped salt domes; 6. underground storage facility for gas condensate created by explosive scouring; 7. planned storage facility for industrial by-products in penetrated levels of the supersalt structural level; cavities of underground nuclear explosions; 8. not filled with gas condensate; 9. with pressing or outpouring of radioactive brine to the bed surface; 10. filled with gas condensate; 11. filled with a wide fraction of light hydrocarbons; wells: 12. for prospecting; 13. operational; 14. hydrogeological. Numbers on the map indicate salt domes: 1. Akhtubinskiy; 2. Aydikskiy; 3. Sary-Sorskiy; 4. Aksarayskiy; 5. Utigenski; troughs: I. Akhtubinskaya; II-I II Aksarayskaya; IV. Yuzhnaya.

The AGCD region, which is a component of the Caspian oil- and gas-bearing basin, is characterized by the presence of two types of fluid dynamic systems in the depths of the earth: closed compression and open gravitational-convection systems. High-pressure closed systems with anomalously high stratal pressures are universally developed in the subsalt level (with pressures of up to 67 MPa, and an anomaly coefficient of 1.48-2.0), and locally in the salt level in sealed lenses of brine (at depths of 3302-3987 m, with a pressure of 65-80 MPa) or in intersalt interlayers, as well as in the supersalt level in the most submerged parts of the interdome trough (post-sedimentation pressing of fluids from the clays at the stage of elisional catagenesis). Gravitational-convection systems are developed mainly in the supersalt level and are united into a Pre-Pliocene fluid dynamic complex with hindered water exchange and in the Pliocene-Quaternary complex in the zone of free water exchange. These are divided by relatively water-resistant clays of the Akchagyl stage.[28] Geothermally, the Astrakhan arch is confined to the zone of maximum temperatures

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observed in the Caspian syncline.[13] It is characteristic that the distribution of temperature over all levels of the sedimentary mantle of the Astrakhan arch corresponds to the geomorphological properties of the region: on the one hand, temperatures rise to the south within the arch, as one approaches the Caspian Sea; on the other hand, the geoisotherms here reach a depth of 3000 m and extend parallel to a geothermal gradient, following the valley of the Lower Volga over its entire extent. The temperatures of the subsalt structural layer of the AGCD is 102-133°C. The salt layer at the 1000 m level varies from 41.2 to 57.3°C, and in the troughs, 86.4-90.7°C. In the surface part of the profile at the level of the neutral layer the temperature reaches 12.5-13.4°C, which is 5-6°C higher than in other regions of the syncline. We note that among the salt dome structures of the AGCD, the most heated zone is the thirteen underground nuclear explosion sites in the region of the Aksarayskiy dome. Here the temperature is 12-15°C higher in the depths than in neighboring domes.

Characteristics of the technogenic effect on the depths of the region before the underground nuclear explosions

In 1836, G. Neshel described a gas show in an artesian column in the area of the city of Astrakhan. This was the beginning of active exploration for oil and gas in the Caspian lowlands.[19] But the depths of the Astrakhan Volga region remained virtually untapped for a long time. In 1911 a powerful gush of oil occurred in the Embinsk region at the Dossor deposit. Exploration work was concentrated for a long time in the southeast part of the Caspian lowlands at Mesozoic levels in the arches of salt domes.

In the early 1930's the research of A.A. Bogdanov and P.A. Pravoslavlev[5,25] in the Astrakhan region revealed a small deposit of natural gases similar to those which were later found in more extensive areas of the Lower Volga region.[6] But industrial development of these deposits was unprofitable at the time, so the depths remained untapped. In 1931 the Vostokneft trust drilled the first deep well in the territory of the city of Astrakhan to explore for gas and oil, and in the 1940's there was a great expansion of the scope of geological and geophysical research. By the end of the 1950's, when the Astrakhan arch was contoured, it became the main object of exploration and prospecting operations in the Caspian lowlands, as the operations in Yuzhnoy Emby had already begun to decline. The tempo of activity picked up in the Lower Volga.

A number of exploratory wells in the Astrakhan arch were drilled with various common methods of seismic prospecting using explosive charges weighing 1 to 1000 kg. In the regional research stage the density of the network of seismic profiles was small, and the explosions were spaced 3-5 km apart. But as the geophysical operations became more detailed, the density of profiles reached 1-2 km per square kilometer with explosion points every 10 m with a single charge mass of from 0.2 to 2. 6 kg [Ref. 3]. As a result, by the 1960's the primary structure of the soil, rock, and water-bearing levels of the Neogene-Quaternary complex of sediments above the Astrakhan arch were virtually universally destroyed to a depth of about 100 m (Fig. 2) . Each explosion formed, on the one hand, a zone of more dense soil from which underground water was squeezed, and on the other, a zone of friable soil with increased permeability. Thus, it is no accident that drastic changes in the natural hydrogeological pattern of surface levels of the Astrakhan Volga region, beginning in 1962, caused a stable elevation of levels of ground water. The regional character of this elevation and its independence of climate changes was noted in Ref. 32.

In addition to the effect of the geological surveying, the behavior of underground water changed due to pumping from many small wells to supply water, and due to the effect of hydrotechnical structures on the Volga River. The effect of the hydrotechnical factor can be judged from the fact that the regional elevation in the levels of underground water sources in the Astrakhan Volga region began in 1960-1952, six to eight years later than more northern regions of the Lower and Middle Volga. This delay can apparently be explained by the fact that the construction of the cascade dams of the Volga hydroelectric power stations at first provided local support of surface levels of underground water. Later, as these waters moved to the main discharge base, the Caspian Sea level, there began a gradual shift in the flood front to the south. In the 1960's the first such flood front reached the latitude of Astrakhan, where there was already increased soil permeability and local support of underground water at many points of seismic surveying explosions.

When the AGCD was discovered in 1973, technogenic destabilization mainly encompassed the water-bearing levels of the Pliocene-Quaternary sediments and only in individual exploration-surveying wells were deeper structural stages disturbed. Consequently, gravity-convection type fluid dynamic systems and less frequently, closed compression type systems were affected. After 1973, when operational wells entered the AGCD there was an increase in the effects of destabilization of the depths, due to unsealing of the AVPD [expansion not given] zones of the subsalt structural stage.

The discovery of the AGCD and other gas condensate deposits lying at greater depths demanded the use of the depths and utilization of raw materials in gas chemical complexes to meet a number of new demands.[17,29,34] First, there was a need for deep refining of all extracted raw materials, since all components of gas condensate were suitable for use. Second, the newly discovered deposits could not be practically used in natural depletion mode, as was the practice earlier at other deposits. This mode insured extraction of only light hydrocarbon gases. But the stratal mixture of the AGCD contained a large amount of hydrogen sulfide condensate (up to 25%), carbon dioxide gas (up to 16%) as well as organic sulfur compounds, and a number of microelements (scandium, rubidium, etc.).[8] Thus, leaving these heavier fractions was unacceptably wasteful. Finally and third, since the gas chemical complex was designed for an operational period of no less than 30 years and required enormous expenditures for its construction, it became necessary to use technology tailored to the

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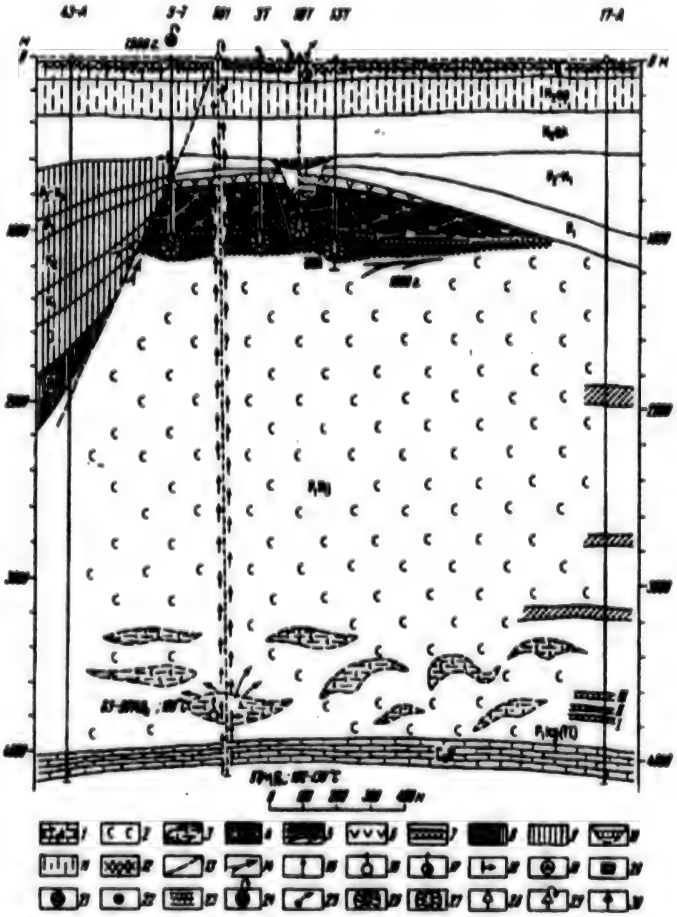

Figure 2. Schematic of technogenic destabilization of the depths of the AGCD in the zone of the underground nuclear explosions.

Key: 1. subsalt structural stage, limestones; salt structural stage; 2. lower substage; 3. zones of brine shows from the AVPD [expansion not given]; 4. upper substage destroyed by split-off phenomena during the explosions and subsequent deformations; 5. zone of junction of microfractures formed during the explosions and allowing shifting of the rock massif in 1986; 6. cap rock; 7. intersalt interlayers (along the core of the wells); supersalt structural stage; 8. high-pressure closed fluid dynamic systems of water exchange; 10. proposed paleo-downcutting of the Pre-Akchagyl or Pre-Paleogene comprised of terragenic rocks; 11. zone of residual water of the Apsheron, Bakin, Khazar and Khvalyn paleoseas, altered by atmospheric factors; 12. zone of activity; 13. fracture 14. influx of underground water into the zone of destruction; 15. breakthrough of fluids outside the column; 16. gas show; 17. gas-water show; 18. absorption of washout liquid; 19. inclusions of anhydrites; 20. inclusions and interlayers of clays; 21. odor of oil in fresh rock chips; 22. bitumen impregnations; 23. inclusions and interlayers of terragenic rock penetrated by water; 24. leakage of radioactive brine; 25. gryphons; cavities of underground nuclear explosions and primary zone of rock destruction; 26. flooded; 27. filled with gas condensate in 1987; wells; 28. prospecting; 29. extraction; 30. technological.

raw material, as well as provision of a stable regular supply of raw materials from the AGCD to the AGRP with minimal changes in the content of the raw material over time. It was difficult to meet this condition at the AGCD because of the complex geological structure of the deposit, the low filtering properties of the productive layer, the AVPD, the inelastic nature of deformations of the collector stratum, etc. Thus, to coordinate operations at the AGCD and the AGRP there were plans to construct impermeable tanks for buffer volumes of high-pressure gas condensate, burial of the products of pipeline installation and the disposal of industrial by-products. When the problem of storing substances which evaporate easily arose at gas chemical complexes, metal and reinforced concrete reservoirs were deemed unac ceptable for a number of economic and technological reasons. It was decided to

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create underground storage facilities in the least permeable salt massifs.[16] However, known methods of creating underground reservoirs, the shaft method and the method of scouring cavities in the rock salt massif, were evaluated to be unacceptable. The first method was expensive and labor intensive, and the second required large quantities of fresh water, the need to dispose of biologically harmful brine, and had a number of other limits. The search for new methods of creating underground storage facilities led to the use of camouflage nuclear explosions for this purpose, which were then used for a number of deposits, including the AGCD.

Creation of underground storage facilities for the AGCD and the development of an emergency situation

In the early 1980's All-Union Scientific Research and Design Institute of Industrial Technology and All-Union Scientific Research Institute for the Use of Gas in the Economy and of Underground Storage of Oil, Oil Products, and Liquified Gases of the Ministry of the Gas Industry of the USSR developed projects to create 15 underground tanks at the AGCD using nuclear explosions in the salt complex. It was assumed that due to the elastic-plastic properties, durability, and relative homogeneity of the rock salt, one could create large stable cavities. This seemed to be confirmed by the experience of using underground tanks at two deposits in the Orenburg oblast, the Sovkhoznoye deposit (one underground nuclear explosion in 1970) and the Dedurovka deposit (three underground nuclear explosions in 1971-1973), which were also confined to the lateral zone of the Caspian syncline. This method was considered reliable at the time because of cavities formed in the Azgir salt dome in the central part of the syncline (ten of the largest underground nuclear explosions in 1966-1978), as well as use of this method in salt domes in the US (the Salmon and Gnome series of underground nuclear explosions in 1966-1973). The calculations confirmed that the construction of storage facilities at the AGCD with underground nuclear explosions would save money, that is, the economic effectiveness of the underground nuclear explosion was equated with technological effectiveness. As a result, 15 tanks were created at depths of up to 1000 m with a volume from 20,000 to 30,000 m^3 each in 1980-1984 at the AGCD.

In 1984, the foreign press reported the first seven underground nuclear explosions at the AGCD[35] and data was published broaching the problem of technogenic destabilization of the depths of the Caspian region, including the AGCD.[7] In this paper, using unofficial information about the underground nuclear explosions, and due to censorship limitations, the author is limited to showing the effect of underground nuclear explosion at the AGCD only graphically.

In repeated examination of cavity 1T it was established that in a year its volume had dropped from 30,000 to 24,300 m^3. However, this was not considered a reason to halt explosion operations and reexamine the initial assumptions of the Vega project. The number of nuclear explosions in 1982-1984 was, respectively, 2, 4, 6, 2. The time between individual underground nuclear explosions in each of these series was 4-5 minutes. Moreover, in 1982, the largest explosion was set off in well 3T. It was nearly twice as strong as the previous and following explosions. Also ignored was the fact that there was a significant scatter in the volumes of individual tanks given the same charge size, which contradicted rules previously established at other sites, and which unambiguously indicated the specific geological conditions at the AGCD.

It should especially be noted that prior to 1986, the volumes of tanks created remained unchanged (with the exception of cavity 1T). But in 1986 there suddenly began a drastic progressive decrease in the size of all 13 tanks, concentrated in the region of the geniculate flexure of the Aksaraysko-Utigenskaya salt ridge (Table 1). (Footnote 1) (The suddenness of the deformations of the underground nuclear explosion cavities in 1986 follows from data from the All-Union Scientific Research and Design Institute of Industrial Technology and requires more careful verification. This year the Gas Industry took over the storage facilities from the Ministry of Atomic Energy of the USSR.)

In 1987, seven of the tanks with already diminished dimensions were filled with gas condensate; two (14T and 15T) were used in the management of operational wells; 2T, 4T, 7VS, 8RT, and 9RT were placed under construction for filling with a broad fraction of light hydrocarbons. Cavities 2T, 4T, 5T, 8RT, and 9RT, due to reduction in volume, were not industrially significant, and were to be eliminated. There were plans to replace them by constructing a new storage facility using scouring. The volume of the seven tanks after they were filled with gas condensate is unknown.

It is important that some of the tanks filled with water and began to squeeze radioactive brine to the bed surface (from December 1988 to June 1989, 12.5 m^3 of brine was taken out of well 5T and buried in cavity 2T with a total radioactivity of about 140 Curies for tritium and 1.4 Curies for cesium-137 according to the All-Union Scientific Research and Design Institute of Industrial Technology).

Thus, it was inappropriate to apply the experience of using underground nuclear explosives to create and use underground storage facilities in salt-bearing strata. Moreover, the long-term stability of underground storage facilities at the AGCD was not confirmed, which inevitably disrupted the coordinated operation of the AGCD and the AGRP.

The sudden and virtually simultaneous reduction in size of all 13 tanks at the AGCD in 1986 indicates that the deformations of the cavities left by the underground nuclear explosions were not local, and probably encompassed the rock massif as a whole. These deformations and flooding of the cavities were caused by a number of natural and technological factors. In addition to excessive confidence in the experience of underground nuclear explosions in salt-bearing strata in other regions, a negative role was also played by the fact that the geological research at the AGCD was not considered. We note that by the beginning

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(a) Год	1Т	2Т	3Т	4ТВС	5Т	6Т	7ВС	8РТ	9РТ	10РТ	11РТ	12РТ	13РТ	14РТ	15РТ
1980	30,0 *														
1981	24,3	32,0 *		25,0 *											
1982			30,0 *		24,0 *	30,0 *	44,0 *								
1983						30,0		31,5 *	32,0 *	20,0 *	35,0 *	35,0 *	25,0 *		
1984		32,0		25,0						20,0				14,0 *	15,0 *
1985			30,0								32,0	39,0	25,0	14,0	15,0
1986	7,7	12,0	10,0	10,0	5,0	7,5	15,0	11,0		12,0	12,0	15,0	10,0		
1987	заполнена газоконденсатом		заполнена газоконденсатом			заполнена газоконденсатом			10,0	емкости заполнены газоконденсатом					
1988					0,1 отжимание и налив рассола										
1989	(c)	1,8	(c)	3,0		(c)	0,2 отжимание и налив рассола	2,0	4,0	(e)					
1990					(d)		(d)								
1991															
(b) Глубина заряда, м	1025	1064	1057	1054	1100	991	973,6	1054	1050	1100	920	1050	1070	1000	1000

* — проведен взрыв. (f)

Table 1. Dynamics of the reduction in size of underground storage facilities at the AGCD, 1000 m^3

Key: a. year; b. depth of charge, m; c. filled with gas condensate; d. outpressing and leakage of brine; e. cavities filled with gas condensate; f. explosion carried out.

of work on the Vega project, several emergencies were already known regarding the use of underground storage facilities in salt strata. This information even reached the open press.[15,31] However, the lessons of these emergencies, as well as the irregularities with 1T, were not learned. Neither did researchers consider experience gained in the study of the lithology, tectonics, hydrogeology, and geodynamics of the underground nuclear explosion zone and the region as a whole. This information had been gathered by specialists at a number of production and scientific organizations in the Soviet Union. Incorrect notions about geological conditions were so ingrained that it freed researchers of the necessity of preliminary and more careful prospecting of the depths and study of natural processes. The ideas that the massif of rock salt was impenetrable, that it was homogeneous, and dry proved to be unreliable, as did information about the locality and welding of deformations after the explosions due to the plastic properties of the rock salt. Criticism of these opinions is extremely important, because they now form the foundation of projects to conserve the malfunctioning tanks at the AGCD and the construction of new storage facilities, and may affect the selection of means of protecting the underground nuclear explosion zone from flooding. We note the errors of the Vega project when we evaluate various factors of the stability of the AGCD storage facilities.

To determine the maximum acceptable depth of bedding of the cavities (using the formula of I. Yu. Shishits) in the Vega project, it was assumed that the cavities would be located in a massif of rock salt whose mechanical properties were determined in dry samples and were identified with the properties of the rock massif as a whole. It was not considered that the salt-bearing stratum of the AGCD has a very mixed composition, because it was built up in the coastal part of the salt-bearing paleobasin, and that the salt structural stage had experienced a number of secondary transformations. One of these invalidated the assumption of the Vega project that the "rock salt" was insignificantly penetrable. In reality, even pure rock salt (as a rock and not a mineral), including that at the AGCD, has a hydrocarbon odor,[18] and contains secondary hydrocarbons which penetrate from the surrounding strata.[1] Not only gas, but liquids can filter through it, as experiments have shown. The mechanical properties of rock salt are also inhomogeneous. At temperatures below 200°C and loads up to 20 MPa it is brittle. At higher temperatures rock salt begins to flow, and then breaks.[9] Thus, even in a massif of pure rock salt, intergrain pores may arise, forming an opening of 4-8 μm and larger gaps allowing fluids to pass through. When a liquid enters the polycrystals of rock salt, the properties of the material are transformed and there is a change in the mechanisms of deformation and destruction. For example, dry polycrystals of halite have a viscosity of 10Pas (almost the same as granite), and after impregnations of moisture, 10^{-6} Pas (Ref. 30). Thus, even if the massif is comprised of rock salt exclusively, its long-term stability and impenetrability is extremely doubtful, especially when there is threat of dampening and heating. In addition to the initially unchanged crystals, a real salt mass if also has zones of development of plastic and brittle (cataclastic) deformations which arise in the development of intrasalt diapirism, which causes the stage-like structure of salt domes and ridges.[22,23] Indicators of an stage-like structure, as already

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noted, were manifested in the geniculate flexure of the Aksaraysko-Utigenskaya salt ridge in the zone where the 13 cavities are concentrated. These cavities are located at depths of about 1000 m near the boundary of two structural substages. The boundary was initially sensitive to shifts. The explosions may have resulted in additional damage due to welding of the fracture zones in framing of each cavity into a single dislocated zone of plastic shape, thus activating a "lubricating layer" at the boundary of the two substages of salt-bearing stratum. The linkage of destruction of the "lubricating layer" with steep fractures and flooded sides of the Aksaraysko-Utigenskaya salt ridge and technogenic fractures arising in framing of nearby operating (as a rule, stand-by) wells also aided in activating the destruction. Moreover, during the explosions split fractures arose in the upper substage of the salt structural stage due to reflected blast waves: a) in the salt-bearing stratum at the boundary with the interlayers of anhydrites and sandstones; b) in the roof of salt-bearing sediments composed of anhydrites and cap rock; c) on the steep sides of the salt massif; d) in the axial part of the syncline, with a northwest strike, comprising the roof of the salt massif (the line of cavities 5T, 3T, 13T); e) on the steep sides of the submerged paleovallies of the supersalt stage (probably the vicinity of cavity 10T).

We note that in the Vega project calculation of break-off phenomena was done only for a horizontally stratified model of the medium and only for horizontal bedding above a water-bearing stratum in a salt massif in a zone with a thickness of not more than a few dozen meters. Unfortunately, these calculations did not consider the results of a study of the destructive effects of a number of reflected pulses during the explosion. The interference of these pulses generates break-off phenomena over the entire rock massif depending on the geometry and acoustic properties of the massif.[26]

In additional to minerals in the halite group, the halogenic stratum of the AGCD contains many interlayers of sandstones, clays, anhydrites or gypsums, dolomites, etc. In a dry state the anhydrites (including no fewer than 12 varieties[4] united into primary-sedimentary varieties, their epigenetic redeposited detrital formation, and metasomatic brecchiated formation) form an insoluble, rather elastic frame of salt series. But in the presence of moisture the anhydrites convert to a gypsum and the volume of the frame increases by up to 30%. As a result, plastic deformations of the frame develop and blocks of rock salt may separate from the walls of the storage facility. The core of strongly deformed anhydrites taken from research wells confirm the reality of this process at the AGCD.

In terms of hydrogeology, the Vega project assumed that the massif of rock salt was impenetrable and completely covered with a water-resistant stratum of substantial thickness. However, in reality, the conditions insuring the hermiticity and water resistance of the blast cavities were not met at the AGCD. Due to sharp facial variability the salt-bearing stratum itself contains water-bearing layers, which was recorded in the certifications of research wells 1R, 2R, 2A, 7T, 11T (these layers had been penetrated even before the explosions). The influx of underground water into individual intervals of the cross section of the salt-bearing stratum in the zone of the underground nuclear explosions varies from 25 to 1000 m^3/day. All attempts to eliminate the influx of underground water by constructing cement bridges proved unsuccessful. For a while the influx of water decreased, but when the wells were pressure tested, the pressure at their mouths usually dropped sharply after 30 minutes. This means that either the cement bridge was not sealed or the water show was beyond the tested interval.

The Aksaraysko-Utigenskaya ridge, which was shattered in the zone of the 13 underground nuclear explosions, later experienced a hydrodynamic effect from all sides: from below (breakthrough of high-pressure water from the subsalt sediments, brine shows, intercolumn flows of the stand-by wells), from the sides (loading of water-bearing levels of Pre-Pliocene sediments at the sides of the ridge) and from above (accumulation of water in the submerged Pre-Paleogenic (Footnote 2) (Local scouring in the Astrakhan arch. Regionally, the Paleogene is associated with deposits of the upper Cretaceous with gradual transitions) or Pre-Akchagyl paleovallies). Almost all of the research wells have poor contact of the cement stone with the rock and casing columns, unsealed cutting joints and shifting the columns after the blasts. In a number of wells one can already note intercolumn pressures of up to 50 atm. Processes generated in the vicinities of the cavities have apparently begun to affect the operating mode of new wells. For example, the drilling of well 5-bis 25 m from research well 5T was accompanied by complete absorption of the clay solution at a depth of 607 m (the roof of the Akchagyl) and absorption of the wetting liquid in the 607-750 m interval. Isn't this technogenic destruction of the water resistance? During drilling of hydrogeological wells in the vicinity of research well 10T (in a radius of 30 to 400 m) there was a gas-water emission with the formation of gryphons and combustion of gas and gushing of a sand-clay mixture to a height of up to 4 m, resulting in the formation of a mud cone more than 6 m in height and with a radius of 30 m, etc. It is possible that these problems in the region of well 10T can be explained not by a technogenic factor, but the gas mode of the Pliocene sediments. To solve this problem one must further study the dynamics of flows in the space between the wells.

The hydrogeologists at the geology department of Moscow State University determined that as soon as the AGRP went into operation, the absolute indicators of piezometric surfaces of underground water in Quaternary sediments gradually rose. However, in 1986-1987 the conditions of bedding of ground water at the AGRP and neighboring territories changed drastically. At this time, a convex ground water table formed with absolute indicators of arch of up to 19 m, which is 4-5 m higher than the levels recorded in 1983-1984. This elevation was accompanied by sharp anomalies in the content of a number of microelements in the underground water. Such drastic changes in the behavior of underground water in the Quaternary

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sediments were linked exclusively with AGRP industrial by-product runoff. However, be aware that these changes coincided in time with the appearance of sudden deformations of the cavities. Thus, there is reason to suggest that in 1986 shifts in the rock massif encompassed not only the zone of cavities, but also recalled the fluid dynamics of overlying levels to the support of ground water levels.

The shifts in the rock massif caused by the underground nuclear explosions must also be linked with the thermal behavior of the depths. It must be noted that the nature of the anomalous geothermal pattern of the Astrakhan arch, as well as the effect of the underground nuclear explosions on the thermal state of the depths and its mobility, have not yet been fully studied.

The geothermal anomaly of the Astrakhan arch, which is typical for oil- and gas-bearing provinces, is due to the combined effect of deep heat flux, physical and biochemical processes in the sedimentary strata, the redistributing effect of the flow of fluids, and the degree of activation of new and current tectonic movements, which determine the lifetime of geothermal anomalies. The newest tectonic movements in the Lower Volga, compared with other regions of the Caspian basin, are distinguished by elevations directly proportional to the contrast of the geothermal anomalies which are significant in amplitude. Frequently these elevations are controlled by the outbursts of discharge fluids, that is, they are linked with hydrodynamic anomalies The current tectonic movements in the lateral zone of the Caspian basin, as already noted, are anomalous, and their intensity has changed drastically since 1977. It is important to note the nonlinear character of temperature gradients and the correlation between the configuration of the geoisotherm of the Astrakhan arch and the configuration of the Volga River valley and contours of the Caspian Sea. This system of two interconnected water basins is constantly subjected to oscillations in level of various magnitudes. The character of these oscillations has changed drastically since 1977, when the level of the Caspian Sea began to rise. These cyclic loads, which are not constant over time, will inevitably affect the stressed state of the depths, and their temperature and gas patterns.

Let us examine possible changes in the thermal pattern of a salt-bearing stratum affected by such loads. (Footnote 3) (The calculations were done by S. G. Gevorkyan, candidate of physical and mathematical sciences, Production and Scientific Research Institute of Engineering Research in Construction of Russia, Moscow.)

When the water level rises by H in reservoirs, the internal energy of the salt-bearing stratum changes (the stratum is operating as an elastic medium on a time scale corresponding to the period of oscillations of the water level in the reservoirs). As a result, the thermal flux changes by a quantity Δq:

$$\Delta q = \frac{\lambda}{cp} \frac{\rho_w^2 g^2 H^2}{2Eh},$$

where λ, c, ρ, E are the coefficients of specific thermal conductivity, thermal capacity, density, and the modulus of elasticity of the rock salt; ρ_w is the density of water in the reservoir; *H is the change in the water level in the reservoir;* h is the thickness of the supersalt stratum of sedimentary rock (its contribution to the change in thermal flux is not considered, since it is assumed that the energy of rock deformatio n is expended completely on its structural reconfiguration) (Fig. 3).

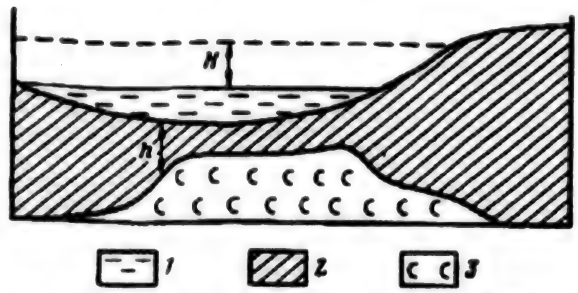

Figure 3. Explanatory schematic of the calculation of the changes in thermal flux.

Key: 1. water; 2. sedimentary rock; 3. salt-bearing strat um.

Thus, λ = 11.286 J/(m s deg); ρ = 2 x 10^3 kg/m^3, c = 0.669x10^3 J/(kg deg); E = 1.5x10^2 MPa; ρ_w = 10^3 kg/cm^3; g = 9.81 m/s^2.

If H varies according to a periodic law, that is (Fig. 4),

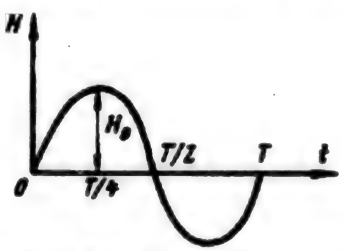

Figure 4. Change in the water level in a reservoir as it depends on time.

$$H = H_0 \sin\left(\frac{2\pi}{T} t\right),$$

where T is the period of oscillations of the water level, t is time, and H_0 is the amplitude of oscillations in the water level, then Δq will also vary according to a periodic law:

$$\Delta q = \frac{\lambda}{cp} \frac{\rho_w^2 g^2 H_0^2}{2Eh} \sin^2\left(\frac{2\pi}{T} t\right).$$

The results of calculation of Δq for various H_0 at the time of maximum water elevation (t = $T/4$) are shown in Table 2,

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H, м	h, м							
	50	100	200	500	600	700	1000	2000
1,0	0,00466	0,00233	0,00117	0,000466	0,00039	0,000333	0,000233	0,000117
2,0	0,0427	0,02135	0,01066	0,00427	0,00356	0,00305	0,002135	0,001056
3,0	0,466	0,233	0,117	0,0466	0,039	0,0333	0,0233	0,0117

Table 2. Increase in thermal flux (Δq, μcal/cm² hr) as it depends on the increase in the water level in the reservoir (H) and the thickness of the supersalt stratum of rock (h).

where it is found that an increase in H by a factor of 3 leads to an increase in Δq by a factor of 10. The absolute values of these changes in thermal flux are small; however, they retain their significance to depths of no less than 2000 m.

The effect of the hydrogeological factor may be more significant.

As already noted, the thermal mode of the Astrakhan arch is anomalous; in particular, the temperatures in the surface part of the cross section here are higher (by up to 6°C) than in neighboring regions. This fact was recorded in the mid 1980s, a quite some time after the subsalt structural stage began to be used.[13] It has not been ruled out that the anomalous thermal mode of the depths of the AGCD are due in no small degree to technogenic break through of thermal water of the subsalt fluid dynamic stage into higher levels. To evaluate this effect we use a one-dimensional equation for thermal conductivity assuming a steady state process:

$$\frac{\partial^2\theta}{\partial z^2} = 0,$$

it follows that the linear dependence of the temperature of the depths θ on depth z is:

$$\theta = Qz + b; \; Q, \; b - \text{const.}$$

Here Q is the geothermal gradient, Q = grad θ; b is the temperature of the neutral layer under normal conditions outside the zone of the effect of thermal waters. Assuming that at z = 4000 m, θ = 180°C, and at z = 0 m, θ = 6°C, with Eq. (2) we obtain Q = 0.0435 deg/m; b = 6°C.

Assuming that the geothermal gradient remains unchanged, that is, that Q = const, the temperature distribution over depth above the zone of breakthrough of thermal waters can be described by a formula similar to Eq. (2):

$$\theta = Qz + b_*,$$

where Q = 0.0435 deg/m, and b_* = 13°C (this follows from the condition θ = 13C at z = 0 m above the zone of thermal water breakthrough). Then, assuming that in the zone of thermal water breakthrough the temperature θ = 180°C is reached at some depth $z = z_*$, from Eq. (3) we obtain $z_* \approx 3839.1$ m. Thus, the new level of underground water lies at a depth z_* = 383 9 m. This means that as a result of technogenic effects the thermal water rose by Δh, $h = H - z_*$ = 161 m.

Consequently, a 7°C change in temperature at the surface of the earth may be due to an elevation of thermal wa ters above their usual level (4000 m) by 161 m (to the 3839 m mark) (Fig. 5). Under real conditions the effect of thermal heating of the depths of the AGCD may be due to many breakthroughs of fluids into the space between the wells, leaking of heat from the cavities of the underground nuclear explosions, etc.

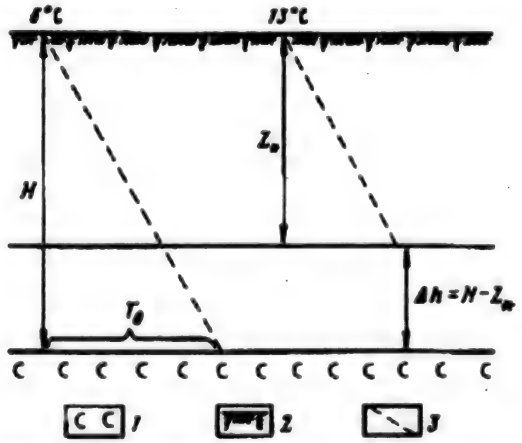

Figure 5. Explanatory schematic for the calculation of conductive heat transfer due to a breakthrough of thermal waters of the salt structural stage.
Key: 1. salt fluid dynamic stage; 2. bed surface; 3. line of change in temperature with depth.

The most extreme changes in temperature were noted at the boundary of the salt domes or within them near the

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intersalt interlayers of anhydrites or gypsums, sandstones, and other rocks. Thus, when the thermal flux changes and there is a thermal effect of thermal water breakthroughs, these contacts are most favorable for the generation of dislocations, thus, destroying the stability of the cavities of the underground nuclear explosions. A consequence of these dislocations, especially in the presence of cyclical loads, may include increased degassing of the depths of the earth, in particular, diffusion of hydrogen sulfides, and this significantly accelerates destruction of the rock massif.[1]

It should be noted that this type of destruction can also be fostered by impact loads due to the hydrological properties of the Volga.[20] Above the apex of the delta, to the city of Volgograd, the longitudinal profile of the bottom of the Volga lies 30-32 m below its erosion base, that is, the level of the Caspian.[24] The range of oscillations of the water level in the tributaries of the Volga varies from 5.5-6.5 m at the apex of the delta to 0.5 m at the sea edge.[11] The volume of water discharge entering the apex of the delta is 232 km^3/year (in 1966-1981), and the discharge of suspended sediments is $9x10^6$ t. The bars of sediments in the delta move with a speed from 50 to 1500 m/year. The most intense erosion activity at the bottom occurs in the period of flood tides or emissions of the water storage facilities of hydroelectric power plants. At this time the most favorable conditions arise for the generation of break-away currents, similar to those formed in front of the ledge of a dam, and may cause powerful impact loads.

Moreover, when there are southerly winds, the water at the city of Astrakhan rises by up to 2 m above the ordinary level and causes reverse currents in the Volga, the high tides of which reach the city of Yenotayevska. When winds are westerly, the drop in the river level reaches 1 m.

Thus, similar to the situation observed when large water storage facilities are filled, the depths of the Astrakhan arch, which experience multiple and continuous shifting of loads, may experience increased activation of shifts up to the seismic level. Whether these loads are so significant that they may provoke tectonic activity is a separate subject for investigation.

These loads, combined with other factors, may aid in unsealing the cavities of the underground nuclear explosions. In this regard, one should focus on the extremely rapid cooling of the blast cavities. It must be considered that the blasts were accompanied by an instantaneous release of a vast amount of energy, equal to $4.2x10^{12}$ J/1000 t of charge, in a small area. The temperature and pressure reached several million degrees Celsius and several million Pascals. The energy that was released was borne by gas formed in the cavity as a result of evaporation of the rock. At the time of the expansion, the internal surface of the blast cavity was covered with a layer of molten rock several centimeters thick with a temperature of several thousand degrees. Most of the thermal energy was concentrated in the blast cavity and its frame, limited to two to three radii of the cavity. If the cavity does not collapse, cooling occurs very slowly Calculations show that at the center point, 100 m from two thermal sources formed by the underground nuclear explosions, the maximum temperature is reached in 120-270 years[26] while at the AGCD the temperature in the blast cavities after only two years was 110-126°C. By 1989 it had dropped to 76°C at almost all points, and in cavity 4T it had even dropped to 59°c, that is, it had reached the natural temperature characteristic for the Aksaraysko-Utigenskaya ridge at this depth (55.7-57.3°C).

This rapid equalization of temperatures confirms that the blast cavities are not sealed. The release of heat from the cavities is sustained without increased heating of the Aksaraysko-Utig enskaya salt ridge and is fostering a loss in the stability of the rock massif.

Conclusion

The technogenic destabilization of the depths of the AGCD, which is steadily increasing over time, had caused an emergency situation in 1986. Other factors played a part in its development, but the main role was played by the underground nuclear explosions. The destruction of the exogenic, followed by the endogenic geological processes by technical means activated dangerous engineering-geological processes in the form of sudden shifts in the rock massif in 1986, and reduction of the volume, flooding and unsealing of the blast cavities. This led to radioactive brines being forced out of the cavities, and finally disrupted the reliable operation of the entire gas chemical complex. The blast cavities have been moved from the category of long-term hydrocarbon raw material storage facilities to burial sites for radioactive by-products which require constant and expensive monitoring. Due to a shortfall of underground tanks, the complete extraction of useful components from the earth may be disrupted, and the stability of supply of extracted raw materials for refining may also be disrupted. A decrease in the reliability of underground burial of the industrial waste products of the AGRP is leading to an increase in harmful emissions into the atmosphere and the need to create new storage facilities. One of these storage facilities has already been created by scouring salt-bearing strata, accompanied by removal to the bed surface of significant volumes of biologically harmful brines, that is, negative shifts in the geochemistry of the landscape have been generated. Moreover, the long-term stability of the newly created underground storage facility is also doubtful, since it is located near the blast cavity zone in the area of active shifts of the rock mass if.

The emergency situation at the AGCD is exacerbated by the threat of flooding to the territory due to the anomalous rise in the level of the Caspian Sea. It is possible that ground and surface water may enter the blast zone via a network of submerged paleovallies of the Pliocene and Quaternary, and possibly of the Paleogene. This water would then join the flow of fluids moving downward from the cavities, and the source of local flooding in the region of the emission of industrial waste water of the AGRP.

The proponents of the exclusively technocratic approach draw attention only to the issue of the radiation situation

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in the vicinity of problem wells and consider the squeezing of radioactive brines from the blast cavities to the bed surface to be an insignificant event. By denying the presence of an emergency situation at the AGCD, they have attempted to play down the miscalculations of the Vega project. This is a dangerous policy because with the problems of ecological protection of the region, preservation of the resource potential of the AGCD, and further use of the gas and chemical complex (one of the largest in Russia), one cannot ignore the number of interrelated processes and the phenomena caused by technogenic destabilization of the earth and other natural complexes which reflect as a whole on the state of ecological and social systems. Specific acceptable methods of solving these problems have not yet been determined. To a significant degree this is due to the fact that the necessary information is being held secret, which is not totally justified. It is not possible to organize advanced scientific studies and perform the appropriate monitoring. Especially urgent is the need to reexamine the fundamentally incorrect notions which formed the foundation of the Vega project. Refinement of these ideas requires improvement of geo-ecological monitoring systems, elements of which have been recently installed at the AGCD, even though they are clearly insufficient.

Using only indirect indicators we cannot now reliably answer fundamental questions: are there deformations in the salt structural stage; were anomalies in the fluid dynamic behavior of the depths of the AGCD particularly localized around the underground nuclear explosion cavities, or did they in 1986 encompass the rock massif as a whole; and are these deformations continuing to develop today?

To answer these questions and derivative questions we must: a) refine the structural-lithological properties of the salt structural stage of the AGCD to a depth of no less than 1200-1500 m; b) determine on a quantitative basis the stages of deformation of the structural elements of the AGCD and the changes in fluid dynamic, thermal, and other behavior generated by these deformations with a consideration of the effect of natural and technogenic factors; c) determine the path of migration of radionuclides from the underground nuclear explosion cavities; d) refine the configuration of the network of submerged paleovallies of the Pliocene-Quaternary and more ancient paleovallies and determine the danger of flooding of the AGCD given the anomalous rise in the level of the Caspian Sea.

When one considers these tasks, the undertaking of the following operations becomes obvious: interpretation of aerospace photographs from various years (before and after the explosions) in order to study the dynamics of the development of fracturing and flooding of the territory; observation of variations in the stressed-deformed state of the rock massif by recording the natural pulse electromagnetic field, recording of microseismic activity with precise gravimetric and geodesic observations coordinated with observations of oscillations in the level of the water basins of the Volga and Caspian, as well as hydrogeological observations.

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Evaluation of Role of Denudation and Sedimentation Processes in Forming Earth's Global Relief

957N0006A Moscow GEOMORFOLOGIYA in Russian No 3, Jul-Sep 94 (manuscript received 14 Sep 93) pp 22-28

[Article by V. M. Litvin, Kaliningrad State University; UDC 551.4.04]

[FBIS Abstract] The average rates of denudation over the entire land surface and on every continent, together with the average rates of sedimentation on the continental plains and ocean floor, were calculated on the basis of geomorphologic and geologic-geophysical data. The accumulative evening out of relief on the continents and on the ocean floor has distinctive characteristics. In the mountain systems on the land on the peaks and slopes of ranges there is intensive denudation, whereas at the bottom of intermontane and piedmont valleys and depressions there is sedimentation of the transported material and the rates of accumulation are rather high. On platforms accumulation occurs at the surface of denudational cutting of the folded-metamorphic basement, initially in the form of a blanketing cover, then in the form of successively accumulating subhorizontal layers of deposits whose thickness increases appreciably in downwarps. On the ocean floor the sedimentary cover lies on the uneven surface of the basalt basement with a characteristic block-ridged relief. There is virtually no denudation of this basement and the sediments on the mid-oceanic ridges initially fill the interridge troughs, then in zones of abyssal hills cover the basement relief with a blanketing cover, but within the limits of abyssal plains completely bury irregularities of the primary relief with a layered stratum of horizontally bedded sediments. The average rates of denudation over the entire land surface and on every continent, together with the average rates of sedimentation on the continental plains and ocean floor, are given in several tables. The average denudation rates are: on the land as a whole—0.082 mm/year, on platform plains—0.035 mm/year and in mountains—0.17 mm/year. The average rates of sedimentation on continental platforms amount to 0.007-0.018 mm/year, on continental margins and in transition zones—about 0.03 mm/year, and on the ocean floor—0.011 mm/year. Figures 3; references 14: 11 Russian, 3 Western.

Denudation of Slopes in Crimea by Small Rodents

957N0006B Moscow GEOMORFOLOGIYA in Russian No 3, Jul-Sep 94 (manuscript received 9 Nov 93) pp 54-61

[Article by A. A. Klyukin, Simferopol University; UDC 551.43:550.74(477)]

[FBIS Abstract] Mouselike rodents participate directly and indirectly in relief formation. Very little attention has been given to the significance of this activity and therefore a study was made of their role in the denudation of the slopes of Crimean plains and mountains, including determination of the dominant direction of movement of the ground and change in the intensity of relief-forming activity of small animals in time and space. The research was done during 1991-1992 in the ravine-dissected hilly-ridged plain of the Kerch Peninsula covered with steppe vegetation and on the slopes of river valleys in the zone of beech forests of the main range of the Crimean Mountains. Mouselike rodents live on slopes covered by a dense grassy cover or forest litter on which characteristic denudation processes are not manifested other than possibly creep and also root uptake and release of matter in a dissolved state. On such slopes the burrowing activity of mouselike rodents and zoogenic denudation constitute the leading exogenous process operative in the upper links of the descending lithodynamic flow. The mean multiyear rates of zoogenic denudation for the slopes of plains and mountains in the Crimea are about 0.06 and 0.01 kg/m^2 per year respectively. These approximate quantities are close to the rate of soil formation and they must not be neglected when estimating total denudation and in balance investigations. The burrowing activity of mouselike rodents is accompanied by a nonuniform lowering and rising of the surface. The uniform indices obtained for the rate of denudation are intended for comparison with the rates of other exogenous processes participating in the denudation of the slopes of plains and mountains in the Crimea. Figure 1; references: 16 Russian.

Estimate of the Diurnal Cycle of the CO_2 Greenhouse Effect With 1D Models of Vertical Atmospheric Structure

957N0017A Moscow IZVESTIYA AKADEMII NAUK FIZIKA ATMOSFERY I OKEANA in Russian Vol 30 No 5, Sep-Oct 94 (manuscript received 2 Mar 94) pp 595-600

[Article by P. F. Demchenko, G. S. Golitsyn, A. S. Ginzburg, N. N. Veltishchev, Institute of Atmospheric Physics, Russian Academy of Sciences; UDC 551.588:551.558]

[FBIS Abstract] Observations of changes in surface temperature in recent decades have shown that increases over vast land areas occur mainly at night; there are only slight changes in daytime temperature. This paper shows that this effect may be partially explained by an increase in the concentration of greenhouse gases in the atmosphere. An analytical model was used to find criteria to evaluate the

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contribution of the greenhouse effect to the asymmetry of the diurnal surface temperature pattern. The diurnal pattern of sensitivity of the Planck function to an increase (doubling) in the concentration of greenhouse gases is contrary to the diurnal pattern of temperature sensitivity. The effect of greenhouse gases on the asymmetry of the diurnal pattern of surface temperature is a consequence of a nonlinear dependence of the Planck function on temperature. The observed secular variations in surface temperature over land masses in individual seasons are not explained by this effect. The role of cloud cover, aerosols, and the hydrological cycle of land masses is indicated. Anthropogenic factors and feedback must be considered. Figures 2; references 8: 3 Russian, 5 Western.

Genesis of Global Climate Fluctuations in the Postglaciation Epoch

957N0017B Moscow IZVESTIYA AKADEMII NAUK FIZIKA ATMOSFERY I OKEANA in Russian, Vol 30 No 5, Sep-Oct 94 (manuscript received 14 May 93; after revision 29 Oct 93) pp 601-607

[Article by A.V. Kislov, Moscow State University; UDC 551 .553]

[FBIS Abstract] A simplified model of general atmospheric circulation is used to conduct computer experiments to study climate sensitivity to changes in insolation at the outer boundary of the atmosphere and surface features. A realistic picture of climatic dynamics in the postglaciation epoch, both on a global scale and for individual regions, is reproduced. A nomalies in temperature, precipitation, and evaporation were reproduced accurately. A key role is played by the Milancovitch effect. Global cold states of the late glaciation epoch arose in response to the appearance of long-lived cold anomalies of the waters of the North Atlantic. Climatic fluctuations of the Holocene are the manifestation of interactions in the atmosph ere-ocean-land system which are developing on a background of features of a climatic pattern caused by the Milancovitch effect. Antarctic surges are not responsible for Holocene cold stages. Figures 4; tables 2; references 30: 16 Russian, 14 Western.

Ozone Layer Disturbances Caused by Tropical Cyclones

957N0017C Moscow IZVESTIYA AKADEMII NAUK FIZIKA ATMOSFERY I OKEANA in Russian Vol 30 No 5, Sep-Oct 94 (manuscript received 28 Sep 93; after revision 10 Nov 93) pp 630-637

[Article by A. F. Nerushev, Tayfun Scientific Production Association, Obninsk; UDC 551.510.534.551.512.2]

[FBIS Abstract] Tropical cyclones have a significant disturbing effect on the ozone layer, and this effect varies both in degree and area. Three types of mechanisms are at work: dynamic, wave, and electrochemical. Dynamic processes are examined in this paper. Twenty-five years of data from a global ozone measurement network and expedition measurement taken in 1984-1990 were used to study spatial and temporal variations in the total ozone content and vertical ozone distribution during development of tropical cyclones in the northwest Pacific and Atlantic. A link was found between observed variations in total ozone content and vertical ozone distribution around topical cyclones at various stages and dynamic processes which determine the evolution of the cyclone or reflect its internal structure. Basic physical mechanisms responsible for the observed ozone variations are proposed. The characteristic increase in total ozone content at the periphery of a developing tropical depression two to four days before it turns into a storm may be seen as an early predictive indicator of tropical cyclone development. Figures 5; table 1; references 22: 13 Russian, 9 Western.

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AGRICULTURAL SCIENCE

Problems of Plant Health

947C0555A Moscow ZASHCHITA RASTENIY in Russian No 7, Jul 94 pp 4-5

[Interview with Sergey Stepanovich Sanin, deputy director, All-Russian Scientific Research Institute of Phytopathology, by correspondent N. A. Tsupkov; place and date of interview not given]

[FBIS Translated Text]

Tsupkov: What in your opinion is associated with the sudden complication of plant health on the farm fields?

Sanin: It is hardly sudden, and it has a history of many years, with its roots reaching down into the mid-1970's, when plant protection was merged with Soyuzselkhozkhimiya [not further identified]. This was the first strategic mistake, the consequences of which we are still feeling today. Like it or not, plant protection was reduced more and more from a polyfunctional sector of plant growing, integrating within itself the agrotechnical, genetic selection, biological, and chemical techniques and methods, into a sector dominated by chemistry.

Another strategic mistake was introducing new agricultural practices in the 1980s—intensive, soil protecting, energy conserving, pesticide-free, and so on. Most of them were insufficiently justified or worked out in the aspect of plant health. They were often transferred in their pure form from abroad, and in a number of cases they helped to worsen plant health under our conditions. Thus, an intensive procedure for cultivating winter wheat developed for the warm, moist conditions of Western Europe was introduced in our former Soviet Union near the Barents Sea, and beside the Pacific Ocean, and in the droughty Volga region, and in moist regions of the West. As a result intensive varieties that provide high yields and are responsive to high doses of mineral fertilizers complicated the situation with the presence of septoria spot, fusarial head blight and barley yellow dwarf. In a number of regions these diseases became more dangerous than all harmful organisms.

Ecologically unjustified and unbalanced use of mineral fertilizers at high norms, chiefly nitrogen fertilizers, foreseen by these practices, promoted an increase in the development of powdery mildew, fusarial head blight and septoria spot, and multiplication of aphids and other harmful organisms.

Retardants and other chemical plant protection resources, used often without regard for plant health on a specific field, often failed to produce the needed effect, making the product more expensive and complicating the ecological situation. The same can also be said about intensive procedures for many other agricultural crops—potatoes, sunflower, sugar beets.

Intensive plant growing does not make it possible to use 8- and 11-field crop rotation systems. In countries of Western Europe for example, at farms specializing in cultivation of cereal crops, three-field rotation is employed: winter wheat, winter barley, early potatoes (or beets). The consequences of crop rotation with short rotation periods to cereal crops are known—intensification of the development of root rot, fusarial blight, rhyncosporium leaf scald, septoria spot, and the spread of dung beetles, Angoumois grain moth, *Hadena sordida* and *Eurygaster*. One of the main causes of epiphytotic occurrence of fusarial head blight in the Northern Caucasus, observed in 1989 and 1992, was saturation of crop rotation by cereal crops, and particularly winter wheat and corn.

Soil-protecting and resource-conserving procedures also have negative consequences to plant health. Unjustified and uncontrolled use of these procedures, particularly replacing plowing with furrow slice inversion by superficial cultivation without compensatory use of chemical plant protection resources led in a number of regions to elevated harmfulness of phytophages inhabiting or surviving in the soil, and to intensified development of root rot, septoria spot, helminthosporiosis spot on cereals, all species of cutworms, and weeds.

Use of superficial cultivation every year without additional introduction of herbicides increases the reserve of weed seeds by 5-10 percent and increased the proportion of malignant rootstock and suckering weeds.

Tsupkov: But why is such worsening of plant health not noted in Western Europe, where intensive procedures are widely employed?

Sanin: There, their introduction was accompanied by heightened attention to plant protection: The number of publications increased, including scientific methodological recommendations in this area, attention to ecological problems grew, and research on diseases of anthropogenic etiology, as well as on directions such as resistance to pesticides and so on, was intensified. The role of plant health predictions in determining the tactics of plant protection increased.

Tsupkov: But in my opinion we also have many publications, especially on intensive procedures.

Sanin: Sure, but consider what they are. The country was inundated with standard "land development manuals" or "cultivation procedures" that accounted for neither zonal agroclimatic conditions, nor the composition of pathogenic complexes, nor purely Russian social and economic factors. We analyzed the sections on plant protection in the recommendations on cultivating cereal crops in a number of oblasts of the Nonchernozem zone: Maintaining the needed plant health on the fields by means of the advice offered in these manuals is practically impossible.

Tsupkov: But what makes these aids and recommendations bad? They are illustrated well, and they are written in understandable language.

Sanin: They are nothing more than advertising prospectuses providing a more or less complete description of soil working procedures, creation of tracks for soil working

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equipment, and use of fertilizers to arrive at a preprogrammed yield. The sections on plant protection are reduced to just a list of the diseases, pests and weeds, and to brief comments. It is stated in some places on the production charts that when signs of disease appear, the crops must be processed with a certain pesticide. And that's all! There is nothing here about agrotechnical methods, or recommendations for using particular varieties, or improving seed material, the thresholds of harmfulness are not presented, and so on.

This is despite the fact that as we know, a resistant variety, a complex of agrotechnical measures, and sensible or, as we commonly say now, directed chemical protection are the basis of integrated protection.

Tsupkov: Sergey Stepanovich, if I understand you correctly, you believe that the main cause of the deterioration of plant health is loss of independence of the plant protection service, weak technical support, and transfer of intensive practices accepted in the West without adapting them to our condition.

Sanin: A complex of causes was responsible for deterioration of the plant health situation—strategic, scientific and methodological, and organizational and economic. I've only talked so far about the strategic ones, although the others are of no lesser significance. Thus, in recent years septoria leaf of cereals, fusarial head blight, barley yellow dwarf virus, leaf spot of various etiology and bacteriosis have become significantly widespread on Russian fields, and the plant protection service is falling seriously behind in diagnosing these diseases. Many widely employed methods of diagnosing these pathogens, such as immunoenzymatic analysis, immunofluorescent analysis, and genome dactyloscopy are simply inaccessible to practical workers.

When it comes to other scientific and methodological causes, it must be said that the principles by which we develop forecasts have grown obsolete, and they do not correspond to either the contemporary level of theoretical developments or to the new economic and social conditions that have established themselves in the country.

I have already spoken many times about the imperfections regarding the economic thresholds of harmfulness recommended as the main criterion on the basis of which to make decisions regarding implementation of chemical protective measures, and I have emphasized the need for taking a differentiated approach to every field when choosing the protection tactics, accounting for differences in yields, agroclimatic conditions, the plant health situation, the prices of pesticides and fuel, the product that is obtained, and so on.

The recommended thresholds have long been obsolete, nor do they correspond to the new economic conditions or to the modern principles of managing plant protection. The All-Union Scientific Research Institute of Phytopathology has developed the concept of plant health diagnostic systems, which accounts for the complex of phytopathological, agrotechnical, meteorological, economic and other indicators.

And then there's the last block of causes—organizational. The equipment availability to the plant protection service is critical. It does not have the necessary equipment, instruments, tools or visual aids. Computers are absent, and this makes it impossible to upgrade to modern forecasting and information support systems. The service has practically no transportation: There are no transportation resources at rayon (interrayon) warning and forecasting stations, which service 200,000-300,000 ha of fields and plantations, and they are not even included on the lists of authorized equipment.

The availability of pesticides for plant protection is worsening with every year. I already said in a previous article that because of their high cost to many agricultural producers, pesticides have simply become inaccessible, and this harbors serious consequences.

In the Russian Federation Supreme Soviet

947C0397A Moscow ZASHCHITA RASTENIY in Russian No 9, Sep 93 p 5

[Article]

[FBIS Translated Text]

On the Basis of the Results of Parliamentary Hearings

An expanded conference of the Committee on Questions of Ecology and Rational Utilization of Natural Resources, the Committee on Social Development of Rural Areas, Agrarian Questions, and Food, and the Committee on Health Protection with the participation of the Agro-Industrial Complex Department of the RF Council of Ministers, the apparatus of the RF Government, and managers, scientists, and specialists of various ministries and scientific, production, and public organizations was held in the RF Supreme Soviet on 10 June. The problem of the utilization of plant protection agents in agriculture and forestry and the organization of the production of modern, new equipment for pesticide application were discussed. We discussed in detail the course of the meeting in the journal's August issue.

Introduction of Ecological Measures Into Plant Protection on Small Peasant and Private Farms

947C0397B Moscow ZASHCHITA RASTENIY in Russian No 9, Sep 93 pp 5-6

[Article by V.N. Pisarenko, head of the Department of Ecology and Botany of the Poltava Agricultural Institute]

[FBIS Translated Text] In our opinion, the appearance of small peasant and private farms changes the strategy and tactics of plant protection in many respects. Measures, which are not too complex and, moreover, make it possible to preserve agricultural products, not disturbing the ecological balance, are put in the forefront. There is a variety

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of methods of optimizing the phytosanitary state of crops, which can be used by farmers.

The establishment of favorable conditions for attracting and developing local entomophages (parasites and predators of pests) is one of them. Predacious ground beetles, hover flies, syrphus flies, tachina flies, ichneumon flies, lady bugs, and ants are the main useful insects. The inclusion of nectar plants (phacelia, buckwheat, mustard, dill, parsley, and so forth) in crop rotations increases the density and activity of entomophages three- to ten-fold. These plants attract useful insects and provide additional feeding for them.

Research by I.O. Yastrebov (1991) established that, when dill was sown at a distance of 50 meters from cabbage plots, the degree of parasitism of cabbage moth caterpillars with Ernestia increased from 30 to 35 percent and with Exetastens, from 60 to 63 percent. The infection of cabbage butterfly caterpillars with Apanteles, when nectar plants were sown near plots (up to 15 meters), reached 60 to 65 percent and with Pteromalus, 25 to 30 percent. On large fields—with an area of 50 hectares and more—it is recommended that nectar plants be placed along the plot perimeter. Fennel, coriander, and anis are most appropriate for cabbage agrotechnology. When sown at the same time, they bloom from May through September. Their flowers are not only suitable for additional feeding of entomophages, but also repel many butterflies, whose caterpillars damage cabbage.

Sowing phacelia along peas in strips 40 to 50 meters wide promotes a reduction of the damage done to plants by the leguminous aphis and to seeds, by the pea weevil. The same effect was obtained when phacelia was sown along beans. The damage done to seeds by the bean weevil was reduced sharply.

We established that the infection of eggs of the corn borer with parasites in crops of corn placed next to a phacelia field reached 46 percent and of caterpillars, 32.7 percent, whereas at a distance of 1,000 meters from phacelia these indicators decreased to 18.7 and 8 percent respectively. Our experiments confirmed the phytosanitary expediency of growing corn with soybeans. For example, whereas in pure sowing the damage done to corn by the corn borer comprised 40.5 percent, as it was saturated with soybeans, this indicator dropped to 34.2 percent with a sowing plan of eight corn rows and eight soybean rows and to 22.7 percent with a plan of six rows of each crop.

In order to attract useful insects to orchards and gardens and to increase their life span and fertility, the establishment of a flower-nectar conveyer, that is, the sowing of phacelia, buckwheat, mustards, and so forth in row spacings at different times, is recommended.

The Larvaevoridae family or tachina flies are some of the numerous entomophages. They destroy such dangerous orchard pests as lackey and gypsy moths, various sawflies, leafrollers, moths, and pyralids. The presence of wild and cultivated carrots, parsnip, goutweed, and other umbelliferous plants promotes the survival and accumulation of these flies on the plot.

If the plots allocated to farmers are on slope land located near reservoirs, where treatments with pesticides are prohibited, we recommend strip sowings of various agricultural crops across the slope. This method will make it possible to significantly increase the effectiveness of local entomophages, especially in the presence of strips with perennial grass. For example, the infection of eggs of the shield bug with Telenomus in winter wheat located in strip sowings was 3.4-fold higher than in ordinary ones. The infection of larvae of stem sawflies increased 2-fold and that of green bugs, 2.3-fold. The death of caterpillars of the corn borer in such corn sowings increased 2.2-fold.

An increase in the specific diversity of plants on a limited territory makes it possible to establish agrobiocenoses, in which the mass reproduction of harmful insects is almost ruled out.

Another method is based on the disorientation or repulsion of pests from orchard and vegetable crops and berry bushes. Each plant species gives off its own smell characteristic of it alone, according to which insects are oriented. If there are many smells, or fragrant secretions, for example, of the apple tree are weaker than of the tansy growing nearby, this complicates the orientation of pests to a significant extent. In particular, this explains the fact that in companion sowings there are much fewer harmful insects and the damage to the harvest done by them decreases sharply.

Plants secreting phytoncides (onion, garlic, mustard, dill, parsley, pot marigold, phlox, nasturtium, and so forth) serve the same purpose.

For example, when strips of field kale and tomatoes are alternated, the damage done to kale by turnip fleas, leaf beetles, and aphids decreases. Planting celery as a companion crop to kale lowers the damage done by the cabbage root fly, because the smell of celery repels it.

The sowing of onions and carrots in alternating rows virtually rules out the damage to onions by the onion fly and to carrots by the carrot fly.

Many butterflies do not tolerate the smell of hemp and nasturtium and do not lay eggs in plants located close to them. Therefore, it is advisable to grow two or three plants under every tree and haphazardly over the entire plot territory.

The sowing of pot marigolds among vegetable crops protects them against mites, fusarial wilts, and root rots; of celery, sharply reduces the damage by blue fleas.

Dill is planted in order to repel many harmful insects, which do not tolerate its sharp smell. Therefore, it is sown haphazardly over the entire plot territory from May through August.

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For the control of bud mites it is recommended that onion and garlic be sown among currant and strawberry bushes in rows or groups, leaving them in the earth for winter.

If tomatoes are planted in row spacings of the gooseberry, it will no longer be damaged by sawflies.

When marigolds are planted along the edges of potato and strawberry beds, usually, in May, the damage by nematodes decreases sharply.

Tansy planted under apple and plum trees promotes a significant reduction of the damage done to fruits by moths. Flies, moths, and fleas do not tolerate the smell of tansy. Tansy should be planted not with seeds, but as an entire plant with the rootstock.

A great number of such examples can be cited.

Under conditions of small peasant and private farms mechanical and physical plant protection methods can find wide application. They include ecological traps (bait concealers), light traps, trapping ditches, thermal processing of seeds and planting stock, and so forth.

For example, kvas traps are effective for catching butterflies of the apple moth, while troughs with fermenting syrup, for catching harmful cutworms (cabbage, winter, heart-and-dart, and clover cutworms).

Mole crickets are trapped in half-liter jars with water buried in the earth flush with the upper edge in places of their mass accumulation. This method can also be used against carrion beetles, nocturnal ground beetles, click beetles, and so forth.

Yellow glue traps are effective for reducing the population of the hothouse whitefly. Moths of the whitefly prefer a bright yellow color, fly to it. and stick to it. A yellow-colored film, to which an adhesive (pestifix, syrup, lanolin, and so forth) is applied, is convenient in use. Traps are hung around in terms of 2 square meters of the sticky surface per 100 square meters of the hothouse. By means of yellow glue traps it is possible to catch 60 to 80 percent of the adult pest specimens. Bait plants can be used in the same manner. In order to attract the whitefly, simultaneously with the planting of cucumbers and tomatoes, tobacco is planted every four to six rows near the heating system, or pumpkins (every 1 to 1.5 meters). Usually, pests lay eggs on the leaves of these crops and then, when leaves are already covered with the whitefly, they pass to cucumbers. As they are colonized by eggs, larvae, and nymphs, whiteflies tear them off and destroy them. The technique of using soybeans in order to reduce the population of the spider mite on cucumbers is similar.

Many so-called folk remedies have not lost their significance. Infusions and decoctions from various plant species are the main ones. In particular, hot red pepper, garlic, common wormwood, potato tops, monk's rhubarb, common onion, mustard, tomato tops, real and rustic tobacco, common celandine, common pansy, and marigolds have insecticide or fungicide properties.

For example, garlic can be used to reduce the population of aphids, slow worms, and spider mites on fruit crops and against the Phytophthora of the potato, the spider mite on cucumbers, and aphids on cabbage. A total of 20 to 30 grams of crushed garlic per pail of water are taken, infused during 24 hours, and filtered. Then plants are treated with this infusion.

Tobacco dust is used to destroy aphids. One part of tobacco dust is taken, 10 parts of water are poured over it, it is infused for 24 hours, and filtered. Before spraying it is diluted in two parts of water and 40 grams of soap per 10 liters of the infusion are added.

Microbiological preparations are also used for protection against leaf miners on vegetable crops. They include bitoxybacillin, dendrobacillin, lepidocide, gomelin, and so forth. Biopreparations should be used at an air temperature not below 18°C; for example, bitoxybacillin for the treatment of potato plants against the Colorado potato beetle during the period of the mass hatching of larvae of age I-II. Three sprayings at an interval of 6 to 8 days are carried out. The consumption norm is 2 kg per hectare.

The application of fertilizers, biohumus, and growth regulators will also make it possible to significantly reduce the development of harmful organisms in crops.

For example, when corn crops were treated with ammonium nitrate and urea solutions in doses of 20 kg per hectare, the death of 53 to 65 percent of the caterpillars of the beet webworm of younger ages was noted. During the consumption of 24 kg of ammonium nitrate per hectare the number of larvae of the red-breast leaf beetle on spring barley crops was reduced to almost one-half.

Mineral supplements enable the plant to regulate the metabolism and to intensify the synthesis, which sharply impairs the feeding of sucking insects—leafhoppers, bugs, aphids, and thrips.

Let us dwell in detail on a new substance of organic origin—biohumus.

Biohumus is the product of processing of the organic mass by earthworms, in particular by the red California worm. It contains macro- and microelements, amino acids, humic acid, and gibberellins in readily available form. It is best to apply it locally, directly under plants, or jointly with seeds. The technique of obtaining it is well developed, is not labor intensive, and is within the power of any farmer.

For example, under fruit trees up to 1.5 kg per tree are applied and under berry bushes, up to 1 kg. A mixture of biohumus and peat in a ratio of 1:1 plus an equivalent of mineral fertilizers equal to their amount in biohumus is most acceptable for seedlings of vegetable crops. Seedlings on biohumus develop 1.5-fold more rapidly, are hardly sick, easily tolerate transplantation, and increase the yield by 80 percent.

During the season liquid dressings with a biohumus solution are effective: 200 to 300 grams per 10 liters of water and 2 to 4 liters of the solution per square meter.

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The enumerated nontraditional methods make it possible to grow agricultural products with a minimum use of pesticides. The application of chemical agents is advisable only during a mass reproduction of pests, or when the time of application of other methods is missed. However, even in these cases one should make an attempt to limit oneself to strip or edge treatments and carry them out during periods when entomophages lead a hidden way of life, or during the prevalence in nature of stages of development of useful insects resistant to pesticides.

What's New in Moldova

947C0555B Moscow ZASHCHITA RASTENIY in Russian No 7, Jul 94 p 6

[Interview with Iosif Ilich Libershteyn, deputy director of the Moldovan Scientific-Technological Institute of Agrochemical Services to Agriculture, by Yu. N. Neypert; place and date of interview not given]

[FBIS Translated Text] It is no longer all that easy to get information from the former union republics. And not because there is no interest in it on the part of readers, or because local authors do not wish to write to us. The difficulties lie in communication, in mail delivery, in the high expense of travel. Considering this, when during a certain conference this correspondent met with Iosif Ilich Libershteyn, the deputy director of the Moldovan Scientific-Technological Institute of Agrochemical Services to Agriculture, he did not miss the opportunity to ask him what was new in the plant protection service of this republic, the experience of which had invariably been the object of study and imitation in the past.

Neypert: And so, what's new in Moldova, Iosif Ilich?

Libershteyn: Well, I don't know if it's good or bad, but there haven't been all that many changes. We have the same difficulties you see in other CIS states—absence of funds for our existence, disruption of economic and organizational ties, and so on. Consequently over the last several years our Green Cross service has suffered many losses, especially in personnel. And all of this has affected the great strength reserve that we had accumulated over many years. I'm referring to the qualified specialists, and the traditionally high respect shown to plant protection by not only farmers but also the country's public. But anyway, believe it or not, last year Moldova gathered high harvests of practically all agricultural crops, something which had not occurred for several years in succession. And plant protection specialists made a sizable contribution to this.

Greater attention to agrotechnical resources for preventing and controlling disease organisms had an effect, making it possible to significantly reduce the need for chemicals.

The state supported us by not rejecting centralized purchases of imported products, such that production was basically supplied with enough pesticides for the most critical purposes, specialists remained in most of the farms, and the forecasting service was able to work.

Neypert: Did the service undergo any structural changes?

Libershteyn: No, with the exception that the republican service has become much "thinner." Although the search goes on. Plant protectors must find their place in new agrarian organizations—commercial farm associations and private farms. Privatization of the land has started, and many problems have become acute. Upon whom are the rayon stations to rely under the new conditions? My opinion is that they will have to work not with individual farms, but with commercial farm organizations, which will also have their own specialists, and everything necessary to organize protective measures at a modern level.

The "dachniki"—owners of garden and orchard plots—have also announced their presence in full volume. They should not be forgotten either. The Plodorodiye Association, and perhaps many other organizations, will take on the job of opening consultation centers, and stores selling pesticides, biological preparations in small packages, and spraying equipment.

Neypert: What are the procedures in regulating the use of pesticides?

Libershteyn: One thing that is fundamentally new is formation of the first national List, and establishment of the State Commission on Chemical Resources. The assortment of preparations is being improved along the lines of making them ecologically safe: Not only agents that are no longer used in Moldova, but also those that have grown obsolete in light of modern hygienic and toxicological requirements have been excluded. In this same direction, new regulations have been made more specific: In many cases the dose rates and the number of applications have been decreased, and the ranges of doses, which were too wide in the former unionwide List, were narrowed.

Neypert: Are there any plans to adopt a state law on plant protection?

Libershteyn: Such a law is being drafted, and it has been distributed for discussion. But as for when it will be approved, that's hard to say; our legislators have too many other things to do.

We are presently living with concern for the new harvest. If only things would go at least as well as they did last year! And after that, we could begin thinking about the future.

Neypert: Good luck to you!

New Boom Sprayers

947C0555C Moscow ZASHCHITA RASTENIY in Russian No 7, Jul 94 p 20

[Article by S. V. Semirak, division director, GSKTB Selkhozkhimmash, and G. N. Petrovskiy, chief design engineer; UDC 632.982:631.348.45]

[FBIS Translated Text] The rising cost of pesticides and the tendency for them to continue to grow more expensive require a more persistent search for more-economical and safer procedures for chemical plant protection. One such project at the GSKTB Selkhozkhimmash [State Special

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Design and Technological Office for Agricultural Chemical Machinery] was to design two new pneumatic boom sprayers, the OPSh-320 and OPSh-630, which have been recommended for production. They are capable of hydropneumatic atomization of a working fluid into fine droplets with a diameter of 100-200 microns, and they are able to force the air-liquid mixture in and around the foliage. Because the coverage is more complete, especially of the leaf undersurface, this makes it possible to reduce pesticide consumption by not less than 25 percent in comparison with currently effective norms, and to decrease liquid consumption to 20-75 liters/ha. Both machines can work a half or even a full shift on a single tankful.

The sprayers are suspended on MTZ-80/82 tractors. The main tank with its hydraulic agitator and two smaller tanks for the flushing liquid and foaming agent are mounted on the sprayer frame. There is also a small tank for clean water (for hand-washing). The power-generating set includes a self-priming centrifugal pump and a vortex fan. Pneumatic sprayers with individual filters having a mesh size of 0.4 mm and shut-off devices are positioned on a five-section boom. There are no regulating and shut-off components in the air line, while the hydraulic line is equipped with a self-cleaning centrifugal filter with a mesh size of 0.4 mm, as well as a shut-off valve a shut-off ball cock and a ball working fluid flow regulator. The foam marker consists of a foam generator powered by the tractor compressor, an electromagnetic valve that switches the foam feed by remote electric control, and two foam reservoirs located at the ends of the boom.

The sprayer tanks and the main components that come in contact with the working fluid are made from corrosion-resistant materials.

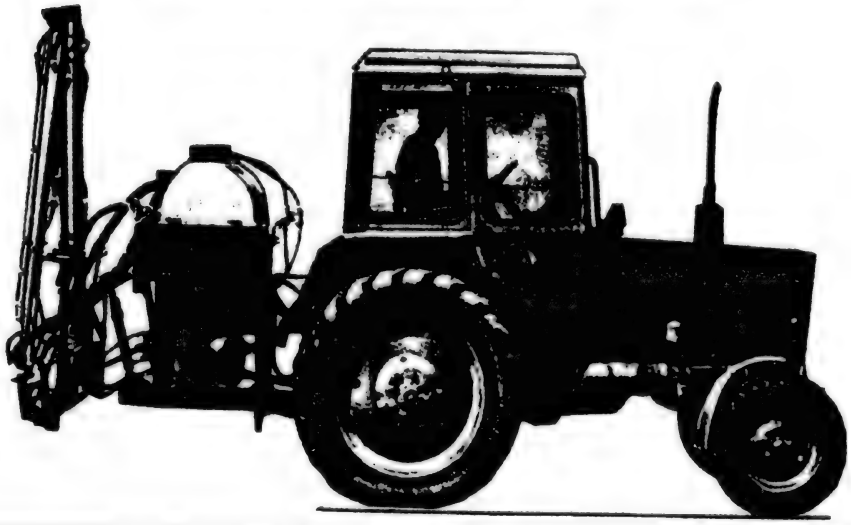
The sprayers are powered by the tractor's power take-off shaft by way of a universal joint, an intermediate support and a two-stage V-belt transmission reaching to the pump and fan.

Here are some of the features of the new sprayers: Two-time dispersal of the working fluid by pneumatic atomizers: hydraulic—primary, pneumatic—secondary; spill-free adjustment of the working mode; remote control (from the tractor's hydraulic system) of the hydraulic line's shut-off valve (open-closed) and the spraying boom (folding-unfolding, raising); contact free removal of the filter element and its hard precipitate by the operator when cleaning the centrifugal filter.

The working fluid is dispensed through the tank's filling spout, or by the unit's centrifugal pump by way of a filling hose. The mesh size of the filling filters is 0.5 mm.

Tests on the machines showed that with hydropneumatic atomization of the liquid (50 liters/ha), the biological effectiveness of Roundup was 11-55 percent higher than in the case of hydraulic atomization (200 liters/ha). A similar result was obtained with insecticides. While consumption of preparations was reduced by 25 percent, not less than 80 percent of weeds and pests were destroyed.

OPSh-630 Sprayer Coupled to an MTZ-80 Tractor



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Technical Description of the Sprayers

	OPSh-320	OPSh-630
Operating productivity (ha/hr)	3.6-7.7	3.8-7.8
Tank capacity (liters)	320 +/- 20	630 +/- 20
Structural weight (kg)	600	630
Working span (m)	12	
Operating speed (km/hr)	6-12	
Working fluid consumption (liters/ha)	20-75	
Median mass diameter of droplets of atomized liquid (microns)	100-200	
Consumed power at tractor power take-off shaft rpm of 1,000 (kW)	Not more than 10	
Sprayer boom adjustment height (mm)	700-1,400	
Span of pneumatic sprayer (m)	Not less than 0.8	

The new sprayers are more economical owing to spill-free adjustment of the operating mode and cleaning of the centrifugal filter without having to pour working fluid out into the environment. The technical operating reliability is high as well. The throughput of the centrifugal filter was increased, the filtration is effective, and the metering holes on the sprayers are relatively large. The addition of the marker raisers the accuracy of guiding the machinery.

The OPSh-320 and OPSh-630 sprayers do not have any analogues in CIS countries, and their fundamentally new pneumatic atomizers and the centrifugal filter have no world analogues, and are part of the know-how of the GSKTB Selkhozkhimmash.

The GSKTB is interested in cooperating with machine building plants and firms wishing to master series production of the new OPSh-320 and OPSh-630 pneumatic boom sprayers.

BIOTECHNOLOGY

Effect on Splenic Colony Formation by Murine Myeloma and Hybridomas Produced With B Lymphocytes From Various Organs

947C0530A Moscow IMMUNOLOGIYA in Russian No 1, Jan-Feb 94 [manuscript submitted 4 Jun 92] pp 26-28

[Article by O. A. Guseva, T. G. Mikheyeva, et al.; UDC 616-006.448-07:616.155.32-097-092.9]

[FBIS Abstract] B lymphocytes from various organs have differing regulatory effects on the colony-forming ability of hemopoietic stem cells, effects that are mediated through the humoral factors that are secreted by the cells. The nature and mechanisms of the effects of those factors are unknown. The analysis of what underlies the effects requires the production of given amounts of the factors produced by the same B-cell populations. In light of that, the researchers here set out to determine the ability of myeloma and hybridoma mouse cells to affect splenic colony-formation through the soluble products secreted by them and to identify the relationship of such an effect on B-cell origin. They used culture fluids of the cells of murine myeloma and hybridoma cells that had splenic or lymph node B lymphocytes as a secondary parent. The researchers found that the cells of the murine myeloma X-653 and hybridoma 199-1E11, which was produced by fusing the cells of X-653 with B lymphocytes from the spleen of an immune mouse, secreted a factor that suppresses colony formation in the spleen of irradiated recipients. In terms of effect, that factor is similar to the factor secreted by intact splenic B lymphocytes. They also found that the cells of the hybridoma MIK-7 D8 secreted a factor that stimulates colony-forming activity of hemopoietic stem cells, although that effect was weaker than the action produced by the factor secreted by intact lymph node B lymphocytes. At the same time, the culture fluid of the MIK-7 D8 hybridoma, when added to the colony-forming mixture of hemopoietic stems cells and T-lymphocyte precursors, suppresses the colony formation dramatically. Figures 1, references 9: 5 Russian, 4 Western.

Effect of Small Doses of Irradiation on Blast Transformation of Lymphocytes of the Blood of Rats

947C0530B Moscow IMMUNOLOGIYA in Russian No 1, Jan-Feb 94 [manuscript submitted 11 Mar 93] pp 28-30

[Article by N. A. Yeliseyeva, M. Kh. Levitman, Yu. N. Korystov, L. Kh. Eydus, Institute of Theoretical and Experimental Biophysics, Russian Academy of Sciences, Pushchino; UDC 615.849.1.015.4:616.155.32].076.9]

[FBIS Abstract] Ionizing radiation in small doses can have a stimulating effect on the body of animals, increasing body weight, extending lifespan, boosting fertility, and raising resistance to various adverse factors and infections by activating immune response. But the cellular mechanisms underlying those effects are little studied. Of especial interest are the mechanisms associated with the stimulating effects that small doses of radiation have on immunity. One factors associated with the activation of immune response is the enhancement of the reproduction of mobilized cells. The researchers here studied the effect of small doses of ionizing radiation on blast transformation of lymphocytes from the blood of Wistar rats on the basis of the incorporation of ^{3}H-thymidine in DNA. The cell suspensions were irradiated with a GUBE gamma unit at rate of 5 cGy/min, in doses of 1.5, 3, and 6 cGy either once (before incubation or 19-20 hr after the start of incubation) or twice (before incubation or 19-20 hr after the start of incubation). Some suspensions were irradiated with a dose of 0.09 cGy from a ^{60}Co source at a rate of 0.09 cGy/hr 20 hours after the start of the incubation. The researchers found that the irradiation itself did not stimulate proliferation of the lymphocytes. But in combination with mitogen, it was capable of amplifying the stimulating effects on the cells of the immune system. Figures 5, references 11: Russian 7, Western 4.

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Physiologic-Biochemical and Photoenergetic Features of Soft Winter Wheat Mutants Induced by Chemical Mutagens

947C0554B Moscow IZVESTIYA AKADEMII NAUK. SERIYA BIOLOGICHESKAYA in Russian No 1, Jan-Feb 94 (manuscript received 21 Jun 93) pp 38-47

[Article by S.A. Stanko and T.V. Salnikova, Chemical Physics Institute imeni N.N. Semenov, Russian Academy of Sciences, Moscow; UDC 581.192.31:581.174.1: 581.132+575.124]

[FBIS Abstract] An in-depth study examined selected physiologic-biochemical and photoenergetic features of constant forms of mutants produced by treating soft winter wheat seeds with chemical mutagens. The studies were performed on the following three groups of mutants that were produced 10-18 years ago by treating seeds of Belotserkovskaya 1980 soft winter wheat with the chemical mutagens N-nitroso-N-alkylurea, 1,4-bis-diazoacetyl-butane, and ethyleneimine: close-spiked, "productive" (characterized by a large number of spikelets in the spike), and spherococcoidal). Specimens of the wheat grown from the mutagen-treated seeds were compared with specimens of the starting variety and the standards Mironovskaya 808 and Zarya. The studies were performed on the first leaf and roots of 8-day-old seedlings and on the flag leaf of plans in the ear formation-initial flowering stage. The following were measured/studied: nitrate reductase activity in the first and flag leaves and roots, number of reaction centers in the plants' photosystems 1 and 2, level of cytoplasmic and structural proteins of the plastid and cellular sap pigments, area and specific mass of the leaves, size of the antenna of the light-collecting and focusing system, and intensity of photosynthesis in the leaves. The nitrate reductase activity in the leaves of all three types of mutants was found to exceed the analogous activity levels of the starting variety and comparison standards by factors of 1.4-1.5, 1.3-1.9, and 1.9-2.1, respectively. Nitrate reductase activity levels in the mutants' roots were also higher than those of the starting and two standard varieties (by factors of 1.4-1.5, 1.1-1.5, and 1.3-1.4, respectively). A study of the plants' elements associated with photoenergetic activity in the first leaf demonstrated that the mutants have virtually the same total content of carotinoids as the starting and standard varieties but 1.1-1.3 times more chlorophyll (a + b) and 2-5 times more anthocyans than the starting and standard varieties. The number of photosystem-1 and -2 reaction centers in the first leaf of the mutant varieties per square decameter of leaf area was 1.3-1.4 times greater than that of either the starting or standard varieties, and the antennas of the light-collecting and focusing system of the mutants were 1.3-1.5 times larger than those of the starting or standard varieties. Studies of the nitrate reductase activity in the flag leaves of the wheat plants at the beginning of flowering established that in the starting and standard varieties, the activity of the said enzyme increased by a factor of 4.2-4.7 as compared with that in the first leaf of the 8-day-old seedlings. In the mutants, on the other hand, nitrate reductase activity in the flag leaves at the beginning of flowering was only 3.1-3.8 higher than that in the first leaves of the 8-day-old seedlings. All of the close-spiked and spherococcoidal and some of the "productive" mutants had flag leaves that were 1.1-1.2 tim[illegible] larger and had 1.1-1.2 times greater specific masses than [illegible]er the starting or standard varieties did. Photosynthesis [illegible]as more intense in the mutant specimens than in either the starting or standard variety specimens. The more intense photosynthesis discovered in the mutants correlated with a higher content of plastic pigments, more photosystem-1 and -2 reaction centers, larger light-collecting and focusing system antennas, and higher levels of nitrate reductase activity. Tables 4; references 26: 21 Russian, 5 Western.

Immunocytochemical Analysis of Hormonal Status of Animals. Transgenic for Growth Factor Genes and for Mini-Gene of Human Growth Hormone Releasing Factor

947C0527A St. Petersburg TSITOLOGIYA in Russian (manuscript received 30 Jun 1993) Vol 36 No 4, Apr 94 pp 372-377

[Article by V. K. Kazakov, S. Rosokhatskiy, T. V. Ignat'yeva, G. F. Golinskiy and A. F. Smirnov; All-Russian Institute of Genetics and Farm Animal Breeding, St. Petersburg-Pushkin; Institute of Genetics and Animal Breeding, Polish Acadeny of Sciences, W[illegible]rsaw; Institute of Experimental Medicine, Russian Academy of Sciences, St. Petersburg

[FBIS Abstract] Immunocytochemical analysis of the hormonal status of rats, transgenic for the gene of the human growth hormone was described and discussed. Amplification of synthesis of endogeneous growth hormone in somotropes of the hypophysis was demonstrated by the use of polyclonal and monoclonal antibodies. Activity of the allogenic growth hormone gene did not appear in tissue in which this might be expected according to the specifics of MT1 and TAT promotors (liver, kidney, pancreas). Transgenic animals of some generations (F_0, F_1, F_2) showed disturbance of functional morphology of glucagon and insulin-producing cells and an inflammational process in the islets of Langerhans. The transgenic rabbits and swine with the gene of releasing factor of human growth hormone did not show any severe disturbance. Pathological changes appeared in the glucagon-producing cells of the pancreas and in the morphology of the rabbit stomach tissue. The data were discussed in connection with general problems of transgenic activity and its interaction with an endogeno us homolog. References 29: 3 Russian; 26 Western.

The Effect of Ionizing Radiation on Human Muscle Tissue

947C0527A Moscow VOPROSY MEDITSINSKOY KHIMII in Russian (manuscript received 2 Jun 93) Vol 40 No 4, Jul-Aug 94 pp 46-50

[Article by N.V. Kondakova, S.V. Disakovskiy, V.V. Sakharov, O.A. Korleva, et al., Scientific Research Laboratory of Biological Structures, Ministry of Health, Russian Federation, Moscow]

[FBIS Abstract] Biochemical and physico-chemical methods were used to study the resistance of muscle

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proteins in human tissue to γ-radiation. The study used the quadriceps muscle of the thigh of males in the age range of 40-60 years. Muscle was obtained at autopsy within 20 hours after death from accidents. Muscle samples (1.5 g) in test-tubes were subjected to ionizing radiation by γ-quanta of ^{60}Co in a dose range from 10-100 gy and from 1-15 kgy. The ionizing radiation did not change the hydrothermic parameters nor the total and bound water content in the muscle. Irradiation by a 15kGy dose reduced the modulus of elasticity of the muscle three-fold, due to partial destruction of biopolymers of the muscle tissues. The study showed a significant difference in the radiation response of human muscle tissue and connective tissue. Resistance of the muscle proteins to the trypsin effect was unaltered but the rate of pronase-induced hydrolysis increased 1.2-fold. Biopolymers in the muscle tissue could not create radiation cross-linking in the radiation doses studied. High-frequency two-dimensional electrophoresis revealed degradation processes at the molecular level, which increases deformability of the muscle samples. Figures 2; references 12: 6 Russian; 6 Western.

Polarization Fluorescent Immuno-Analysis for sim-1,3,5-triazines Class Herbicides

947C0527C Moscow VOPROSY MEDITSINSKOY KHIMII in Russian (manuscript received 28 Apr 93) Vol 40 No 4, Jul-Aug 94 pp 46-50

[Article by Zh.K. Samsonova, S.A. Eremin and A.M. Yegorov, Moscow University im eni M.V. Lomonosov] UDC 615.285.7.015.46.07

[FBIS Abstract] Development of an express method of polarization fluoroimmunoanalysis of herbicides of the sim-1,3,5-triazines class, especially atrazine, was described and discussed. The minimal determinable concentration of atrazine was 6 ng/ml in a microliter sample. Reproducibility of results of analysis was checked in three control samples containing 10, 100 and 1000 ng/ml of atrazine in 4-10 repetitions in one analysis. The mean values of concentrat ions of the herbicide found along a calibrated curve was 9.2, 105 and 990 ng/ml of atrazine. Analysis was most specific for ametrine and prometine. Sensitivity of the assay was higher when using the "shortest" chemical bridge between the molecule of antigen and the fluorescent label. The method is quite simple, rapid and reliable. It may be used for mass express-monitoring of residual quantities of atrazine in the environment. It may also be used to determine herbicides of the sim-1,3,5 triazines grou p in extracts from different sources during environmental monitoring. Figures 5; references 14: 1 Russian; 13 Western.

Development of Polarization Fluorescent Immunoanalysis of Herbicide 2,4,5-Trichlor Ophenoxy Acetic Acid

947C0527D Moscow VOPROSY MEDITSINSKOY KHIMII in Russian (manuscript received 2 Jun 93) Vol 40 No 4, Jul-Aug 94 pp 46-50

[Article by S.A. Yeremin, O.A. Mel'nichenko, A.A. Tumanov, N.V. Sorokina, et al., Moscow University imeni M.V. Lomonosov, Institute of Chemistry, Nizhegorod University] UDC 615.285.7.038

[FBIS Abstract] Production of specific antibodies and development of polarization fluorescent immunoanalysis of the herbicide 2,4,5-trichlor ophenoxy acetic acid permitted estimation of residual quantities of the herbicide. The method is simple, accurate, specific and permits scanning of 10 prepared samples in seven minutes by an operator of average training. The method can be used to screen high-speed test of the herbicide concentration in waste waters or extracts from different sources in environmental protection procedures Figure 3; references 9: 3 Russian; 6 Western.

EPIDEMIOLOGY, MICROBIOLOGY, AND VIROLOGY

Efficacy of Porous Cermets in Air Purification

947C0562A Moscow GIGIYENA I SANITARIYA in Russian No 1, Jan 94 (manuscript received 23 Jul 93) pp 6-7

[Article by M.G. Kurguzkin, V.K. Rybakov and V.L. Grebnev, Izhevsk Mechanical Institute; UDC 614.72:615.837.3]-074]

[FBIS Abstract] Trials were conducted with three porous cermet filters to assess their efficacy in bacterial decontamination of air. The results showed that PTOM titanium and $CaSiO_3$ filters were effective in completely removing E. coli, staphylococcus and micrococci with a diameter of < 0.5 μ, but that a titanium + carbon black filter passed some of the micrococci. These findings suggest that with further technical improvements cermet-based filters may find ready application in air purification technology. Tables 1; references 5 (Russian).

Effects of Pesticides on Nonspecific Immunity to Infections

947C0562B Moscow GIGIYENA I SANITARIYA in Russian No 1, Jan 94 (manuscript received 24 Jun 93) pp 19-21

[Article by N.V. Chugunikhina and M.I. Khasanov, Scientific Research Institute of Human Ecology and Environmental Hygiene imeni A.N. Sysin, Russian Academy of Medical Sciences; UDC 616.0-092:612.017.1]-02:615.285.7-07]

[FBIS Abstract] Trials on mice showed that 0.05 mg/kg/day (intragastric; 30 days) of phosphamide (organophosphate pesticide; high toxicity) or ambush (pyrethroid; low toxicity) did not affect blood cholinesterase activity, phagocytosis by leukocytes, or serum lysozyme levels. Depression of these parameters with 0.2 and 2.0 mg/kg doses was in each case was statistically significant in comparison with control values and equivalent between the two pesticides, but subsequent intraperitoneal infection with salmonella typhimurium followed a much more severe course in mice on the 2.0 mg/kg regimen. These

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findings demonstrated that both ambush and phosphamide adversely affect nonspecific immunity to infectious agents. This conclusion was confirmed in human regression and correlation studies in Buvaydinskiy Rayon, Fergana Oblast, and Kattakurganskiy Rayon, Samarkand Oblast, where the use of phosphamide is twice as great in the former than in the latter (1.43 vs. 0.59 kg/ha), and accounts for the much greater infectious disease morbidity in the the Buvaydinskiy Rayon. Tables 2; references 7 (Russian).

Sanitary Regulations for Harvesting, Processing and Selling of Mushrooms

947C0562C Moscow GIGIYENA I SANITARIYA in Russian No 1, Jan 94 pp 60-80

[FBIS Abstract]On August 20, 1993, the State Committee for Sanitary Oversight of the Russian Federation enacted new sanitary regulations for the mushroom trade that went into effect on September 1, 1993. The regulations govern the operations of the mushroom industry and provide a legal framework for sanitary and epidemiologic services in their monitoring tasks. The regulations covering the harvesting, processing, storage and selling operations are completed with a descriptive list of approved edible mushrooms.

Ultrastructural Features of the Interaction of Liposomes With Bacterial Cells

947C0545A Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 2, Jan-Feb 94 (manuscript received 12 Nov 91) pp 3-7

[Article by N.A. Pereverzev, V.F. Salov, G.Yu. Grigoryan, and V.L. Popov, Epidemiology and Microbiology Scientific Research Institute imeni N.F. Gamaley, Russian Academy of Medical Sciences, and Vaccines and Sera Scientific Research Institute imeni I.I. Mechnikov, Russian Academy of Medical Sciences, Moscow]

[FBIS Abstract] *Escherichia coli* and *Staphylococcus aureus* cells were reacted with liposomes in a bacterial suspension, and the ultrastructural features of the reaction were studied by electron microscopy. Liposomes containing ferritin were obtained from a 1:1 mixture of phosphatidyl choline [PC] and phosphatidyl ethanolamine [PE] by dispersing a 0.5 ml solution of PC and PE (1:1) (20 mg phospholipids in 0.5 ml diethyl ether) in 2 ml of a 4 percent $NaHCO_3$ solution (pH 9.0) containing 5 mg ferritin, slowly removing the ether, and concentrating the liposomes for 10 minutes with a 2 percent uranylacetate solution. Next, 0.5 ml liposomes (containing 10 mg phospholipids) was added to bacterial suspensions (1×10^9/ml). After 30 minutes of incubation at 37°C, the liposome-bacteria complexes were stabilized by a bifunctional reagent to cross-link the proteins and OH groups of the tyrosine in accordance with the generally accepted method (the process took 14 hours at 4°C). The material was prepared for electron microscopy studies with a YEM-100B electron microscope (Japan) by encasing it and then contracting ultrathin sections with a 2 percent uranylacetate solution. The studies established that after 30 minutes of incubation, suspensions of liposomes and bacterial cells undergo morphological changes that depend on the nature of the microorganisms and size of the liposome vesicles. The mechanisms of liposome interaction with gram-positive and gram-negative microorganisms were found to differ from one another. Gram-positive microbial cells did not make direct contact with the liposomes; rather, an electron-transparent zone always remained between the liposomes and the cell wall. The mechanism of liposome interaction with gram-negative cells depended on the size of the liposome vesicles as follows: small (100-140 nm) and medium (280-300 nm) liposomes were initially fixed on the surface of the bacterial cell but, in all likelihood, did not make direct contact with the cell wall. Next came a second phase in which stable contact was made. The small liposomes continued to maintain their spherical shape, whereas the medium liposomes flattened out along the surface of the microorganisms. A slight invagination of the cell wall was observed; however, its ultrastructure was still maintained. In the subsequent phases of the adhesion process, especially in the case of small liposomes, the cell wall of the bacteria formed deep invaginations, as if capturing the liposome vesicles. In some cases, the said process was accompanied by the formation in the bacterial cell of a wide bloomed area of periplasm as a result of breaking of the structural connection between the cytoplasmic membrane and cell wall. The capture of small liposomes by gram-negative microorganisms was reminiscent of the mechanism of "phagocytosis" by eukaryotic cells. The process of interaction of the medium liposomes with bacteria occurred without the formation of marked invaginations at the surface structure level. Larger liposomes (2-4 μm) absorbed the microorganisms, thereby causing destructive changes in them. Figures 6; references 6: 1 Russian, 5 Western.

Results of Dosed Oral Infection of White Mice With Strains of Plague Causative Agent With Different Plasmid Profiles

947C0545C Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 2, Jan-Feb 94 (manuscript received 27 Nov 91; after revision 25 May 92) pp 15-20

[Article by A.M. Kikushkin, T.N. Donskaya, M.P. Salabuda, Yu.F. Kushnerev, V.N. Chekashov, A.A. Shcherbakov, and V.B. Marysayev, Mikrob Russian Antiplague Scientific Reserach Institute, Saratov]

[FBIS Abstract] A study examined the virulence and propagation of *Yersinia pestis* with different plasmid profiles when it was orally administered to white mice. The virulent *Y. pestis* strains 629 and 358 and previously obtained isogenic varieties of *Y. pestis* with different plasmid profiles were used. The plasmid pCKΔII, which determines resistance to kanamycin but does not affect the other properties of *Y. pestis*, was introduced into all of the strains by cryotransformation. The presence and absence of plasmids was controlled by phenotypic markers and

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electrophoresis screening methods. A total of 302 nonpedigree white mice that had not been fed for the 12 hours before the experiments were initiated were fed granules of a suspension of a 1-day (28 and 37°C) agar culture of *Y. pestis* suspended in a physiologic solution. The median lethal concentration [LD_{50}] of culture grown at 28°C was determined to be 5.6 x 10^7 colony-forming units [CFU] versus an LD_{50} of 1.9 x 10^8 CFU for the culture grown at 37°C. In the case of subcutaneous infection, the values of LD_{50} calculated for the two culture temperatures were 4.0 x 10^2 and 2.5 x 10_1CFU. Thus, unlike in the case of subcutaneous infection, in the case of oral administration of *Y. pestis*, cultures grown at 37°C were less virulent than those grown at 28°C. The dynamics of the propagation of infection throughout the body was studied in 98 white mice infected with agar granules containing 10^8 CFU of the *Y. pestis* strain 629M cultured at 28°C. Of the 98 mice, 21 died within 1 to 11 days after infection, with the number of deaths peaking on days 4-5. In one mouse that died within the first few days after infection, *Y. pestis* was isolated only from the small intestine. *Y. pestis* was found in all organs and tissues of one-third of the mice. In the subsequent days of the experiment, generalization of plague was recorded in another 14 mice. *Y. pestis* could not be isolated from five of the dead mice. The remaining 77 mice were kills, dissected, and subjected to bacteriologic examination every 5 hours during the first few days of the experiment and then daily for 12 days after the time of infection. Just 5 hours after the mice had been infected, *Y. pestis* was discovered in the walls of the small and large intestines of four of the six mice examined. In one of the said mice, *Y. pestis* was also isolated from the spleen. By 15 hours after the mice had been infected, the *Y. pestis* had spread to the animals' lymph nodes. A more generalized form of infection developed 2-6 days after the mice had been infected. The ability of *Y. pestis* to realize several infection transmission mechanisms was attributed to its unique genome. It was concluded that the presence in *Y. pestis* of type-specific plasmids with molecular weights of 6 and 65 MD facilitates more efficient alimentary infection of laboratory animals and development within them of an acute generalized form of infection resulting in death. Up to half the animals that survived oral infection developed antibodies to the capsular antigen and membrane proteins of *Y. pestis*. When the infecting dose was decreased from 10^8 to 10^4 CFU, the number of serum-positive animals decreased sharply. Tables 2; references 15 (Russian).

New Collection of Phages for Titration of Methicillin-Resistant *S. aureus*

947C0545D Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 2, Jan-Feb 94 (manuscript received 16 Dec 91; after revision 10 Mar 92) pp 20-23

[Article by V.S. Zuyeva, O.A. Dmitrenko, K.K. Gladkova, and Ye.A. Zuyeva, Epidemiology and Microbiology Scientific Research Institute imeni N.F. Gamaley, Russian Academy of Medical Sciences, and Central Epidemiology Scientific Research Institute, Russian Federation State Committee for Sanitary-Epidemiological Oversight, Moscow]

[FBIS Abstract] A new collection of phages for titration of methicillin-resistant *Staphylococcus aureus* [MRSA] was evaluated in a clinical trial. The 67 methicillin-resistant strains of *S. aureus* used in the study were collected in 1987-1990 from trauma, burn, and obstetric centers in Moscow, Minsk, and Omsk, respectively. The phages used were the basic international set and a collection of experimental phages produced in the Staphylococcal Infections Laboratory of the Epidemiology and Microbiology Scientific Research Institute imeni Gamaley. Included in the experimental collection were 85 phages from the international collection that had been modified by one of the MRSA strains and 9 phages induced from cultures of MRSA that had been isolated in Moscow in 1975-1977. Phage sensitivity was determined by routine phage titration methods by using a concentration of the phages constituting the routine test dilution and by the agar layer method. Each of the five groups of cultures examined was characterized by sensitivity to one of the six groups of phages in the collection and insensitivity to the others. The phages of each of the groups did not lyse cultures of the corresponding group. The phages and a specified process for evaluating their lytic activity were used to differentiate cultures of MRSA isolated in 1987-1990 from the three centers. Most of the strains isolated from the trauma and burn centers could not be typed by phages of the international set. The strains that were typable by the said phages were sensitive either to phage 85 or else to phage 85 in combination with other phages (87 and 77 or 85, 29, and 95). All of the isolated strains showed sensitivity to the modified phage 85; however, the strains that could be typed by the phages of the international set limited the multiplication of the modified phage somewhat. The MRSA strains that could not be typed by the phages of the international set were able to be typed by the collection of experimental phages. The reproducibility of the phage-typing method involving use of the experimental collection was high because of the fact that it was based on antiphage immunity, i.e., on the specificity of the prophages contained in the cell, which represent a stable feature. An epidemic MRSA was discovered, and the source of its spread in the burn center was established. Tables 4; references 14: 4 Russian, 10 Western.

Experience of Using a Dried Bifidumbacterin Preparation To Prevent Acute Intestinal Infections in Newborns

947C0545E Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 2, Jan-Feb 94 (manuscript received 28 Jan 92) pp 37-39

[Article by N.A. Chernysheva, K.I. Melnikova, M.P. Finkel, and Z.B. Izotova, Moscow Epidemiology and Microbiology Scientific Research Institute imeni G.N. Gabrichevskiy]

[FBIS Abstract] The prophylactic efficacy of using a short course of a dried preparation of bifidumbacterin in newborns at risk of acute intestinal infections was evaluated. A total of 340 newborns who were determined to be at risk of acute intestinal infections developing because of various

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irregularities in the courses of their mothers' pregnancies and deliveries were placed under observation. Half of them received a dried bifidumbacterin preparation at a rate of 2.5-5 doses twice a day beginning on their second day of life and continuing for the remainder of their 4- to 6-day stay in the maternity home. The newborns' intestinal microflora was studied during the first few days of their lives and then 1, 3, and 6 months thereafter. Data obtained from the polyclinic charts of 225 of the children about their frequency of intestinal infections and other diseases (including purulent-septic diseases of the upper respiratory tract, skin, and mucous membranes) during their first 6 months of life were also analyzed. At the end of their first month of life, 77.3 +/- 17.8 percent of the newborns who had received the bifidumbacterin had a normal level of bifidoflora versus only 50.0 +/- 22.4 percent of the control group newborns. During the same period, opportunistic enterobacteria were found in only 27.3 +/- 19.0 percent of those who had received the bifidumbacterin as compared with 50.0 +/- 22.4 percent of the controls. No similar differences in the bacteriologic indicators of the intestinal microflora of the two groups of children were discovered farther on into the study. The incidence of acute intestinal infection during the first 3 months of life was three times higher among the controls than among the infants who had received bifidumbacterin while in the maternity home (20.9 of 100 controls versus 6.4 of 100 bifidumbacterin-treated infants had contracted acute infections). The index of the efficacy of administering bifidumbacterin to newborns considered at risk of acute intestinal infections during the first 3 months of life was thus calculated at 3.1. In addition, among those infants who had received the bifidumbacterin, the incidence of diseases of the skin and mucous membranes of the oral cavity was 1.8 times lower than that of the control infants. The prophylactic effect of bifidumbacterin did not persist into months 4-6 of the infants' lives. It was thus recommended that a dried preparation of bifidumbacterin be administered to newborns who are considered at risk of acute intestinal infection developing and also to infants born during epidemics of acute intestinal and/or purulent-septic diseases. Table 1; references 4 (Russian).

Study of the Activity of Natural Killer and Killer Cells in Persons Receiving Primary and Booster Vaccinations Against Plague

947C0545F Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 2, Jan-Feb 94 (manuscript received 12 Dec 91) pp 99-102

[Article by S.Yu. Pchelintsev, Ye.V. Solokhin, S.V. Yurov, V.I. Urayeva, S.V. Ryazantsev, S.S. Afanasyev, A.P. Savelyev, and A.A. Vorobyev, Immunology Institute, State Concern Biopreparat, Lyubuchany, Moscow Oblast]

[FBIS Abstract] The activity of natural killer and killer cells in healthy male volunteers (aged 20 to 24 years) receiving primary and booster vaccinations against plague was studied. Thirty males were immunized with live vaccine. The 35 males in the control group received a physiologic solution instead of the vaccine. The men's immunologic parameters were determined before administration of the vaccine/physiologic solution and again on days 7, 25, 180, and 365 thereafter. The studies were performed with venous heparinized (30 U/ml) whole blood without removal of the lymphocytes. The functional activity of the natural killer and killer cells was determined in 16- and 4-hour tests. K-562 human myeloleukosis cells served as targets for the natural killer cells, and mastocytoma cells of the P-815 mouse line that had been sensitized by rabbit antiserum in a subagglutinating dilution served as targets for the killer cells. Culturing was performed in vitro in RPMI-1640 medium with 10 percent inactivated fetal serum, glutamine, and antibiotics. Three dilutions of the volunteers' whole blood (1:8, 1:16, and 1:32) were used. Besides testing the activity of the natural killer and killer cells, researchers also determined their sensitivity to genetically engineers human α-2-interferon. Sensitivity of the volunteers' lymphocytes was determined in a blast transformation reaction with radiometric counting of the results. Plague antibodies were determined by passive hemagglutination. By day 180 after the immunization, antibodies had appeared in the blood of 63 percent of the vaccinated volunteers. Of those persons receiving booster vaccinations, increased levels of antibodies developed in 93 percent by day 25 after immunization. Vaccination of the volunteers against plague was found to induce suppression of the activity of mature natural killer and killer cells but to not induce any alterations in the level of their precursors. Administration of booster vaccinations was found to induce more pronounced sensitization of the volunteers' lymphocytes and a higher level of plague antibodies than occurred in the case of primary vaccination. An elevation in natural killer cell activity on day 7 after immunization was noted in the volunteers who received booster vaccinations. A change in killer cell activity was recorded only on days 25 and 365 after administration of the booster vaccinations. It was concluded that the observed elevation in killer cell activity was not the result of direct action of live *Yersinia pestis* cells but rather the result of immunological changes that they induce in the body. Tables 2; references 13: 8 Russian, 5 Western.

New Data About Spread of P-41-Positive Strains of Rabies Virus in Arctic and Non-Arctic Regions

947C0546A Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 2, Jan-Feb 94 pp 53-56

[Article by M.A. Selimov, A.D. Botvinkin, V.V. Khozinskiy, and L.Ya. Gribanova, Poliomyelitis and Viral Encephalitis Institute, Russian Academy of Medical Sciences, Moscow, and Natural Infection Foci Scientific Research Institute, Omsk]

[FBIS Translated Text] Devastating epizootic diseases among polar foxes, draught dogs, and foxes in the Subarctic that have been called various names (going wild, Kamchatka wildness, Arctic rabies, "fits," etc.) have long been known. They are linked to a variety of rabies virus

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that differs from "classic rabies" from the standpoint of several biologic properties [2,9,12,13].

Specifically, there have been observations of the virus's reduced pathogenicity for humans.[3,7,8,11] It cannot, however, be differentiated from "classic" rabies on the basis of its epidemiologic, pathomorphological, and clinical characteristics. As is well known, propagation of this variety of rabies has traditionally been confined to the natural habitat of its main host—the polar fox. P-41 monoclonal antibodies [MAbs] that react specifically with strains from the Arctic regions of the former USSR, Norway, Alaska, and Greenland have recently been obtained.[16] Presented here are the results of a study of rabies virus strains form various regions of the former USSR that was conducted with P-41 MAbs and that complements existing information about other regions of the world.[15-17,19]

Materials and Methods

Two hundred seventy-one strains of rabies virus isolated from humans and wiid and domesticated animals living in different landforms and geographic areas were studied (Table 1). Included in the collection were strains from the tundra and forest tundra of northern Yakutia (form Taymyr to the lower reaches of the Kolyma) and the Kola Peninsula. The Arctic, subarctic, and southern latitudes were represented by strains from Estonia, the European part of Russia, Ukraine, Georgia, Uzbekistan, Kazakhstan, Western and Eastern Siberia, and the southern part of the Far East. The strains were isolated from 1969 to 1991 by intracerebral infection of white mice. Imprints of the white mice's brains were studied at a level of one to five passages.

Table 1. Results of Monoclonal Antibody Study of P-41 Strains of Rabies Virus Isolated From Ground Vertebrates From Different Regions of USSR

Source of Virus	Tundra and Forest Steppe	Other Landforms
1. Man	-	33/2
2. Domesticated dog	3/3	30/5
3. Domesticated cat	-	4/2
4. Cattle	-	8/6
5. Horse	2/2	-
6. Fox	6/6	81/13
7. Polar fox	45/45	-
8. Raccoon dog	-	17/11
9. Corsac fox	-	9/3
10. Wolf	2/2	8/2
11. Siberian weasel	-	4/1
12. Ermine	-	1/0
13. Eurasian badger	0	2/1
14. Lynx	-	-1/0
15. Amur forest cat	-	1/0
16. Alaskan ground squirrel	-	1/1
17. Reindeer	8/8	-
species of animal unknown	1/1	4/0
Total	67/67	204/47 Note: Numerator = no. strains studies; denominator = number of strains positive for P-41.

Schneider et al. (Tubingen, Germany) obtained P-41 MAbs by immunizing white mice with virus isolated from polar foxes from Yakutia,[16] and then they were graciously placed at our disposal. The preparations were studied by the indirect method of fluorescing antibodies. Fluorescein isothiocyanate [FITC]-labeled IgG rabbit antibodies to mouse immunoglobins (Epidemiology and Microbiology Scientific Research Institute imeni N.F. Gamaley, Moscow) were used as secondary antibodies in the dilution specified in the instructions for their use. The results were counted on a LYuMAM-3I luminescent microscope (objective, x90; eyepieces, x5 and x7). Preparations with bright fluorescing inclusions of at least 3-4 crosses that are characteristic of rabies virus were considered positive.

Results and Discussion

Unlike most strains isolated from regions farther to the south, all of the strains isolated in from polar regions reacted positively with P-41 MAbs regardless of the source from which they were isolated. Forty-seven isolates yielding distinct fluorescence with P-41 MAb were, however, detected significantly to the south of the polar circle in four regions that were far removed from one another

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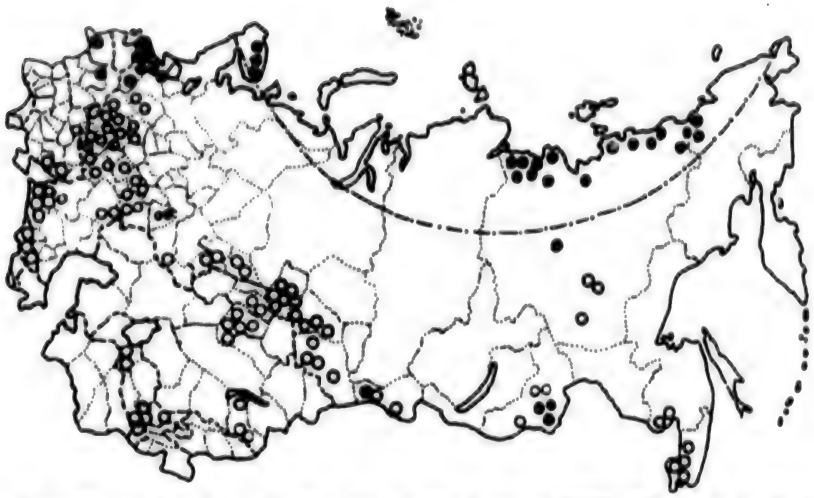

Figure 1. Spread of the "Arctic" variety of rabies virus in the former USSR. (Black circles indicate P-41-positive strains, and white circles indicate P-41-negative strains. [Circles indicate regions in which the virus has been isolated, not quantities of virus.])

(see Figure 1 and Table 1). In the Asiatic part of the former USSR, such strains were discovered in mountainous regions located 300 to 1,700 km from the northern polar circle in the Baltic states, Belarus, and the northwestern region of Russia in a plane extending approximately 700-800 km. As was recently reported,[15] strains isolated in Finland in 1988 close to the Russian border also reacted positively with P-41 MAbs. Finland, the Baltic states, and Central Yakutia are located within the bounds of the territory in which rare runs of polar fox have been recorded.[4] Runs of polar fox are not known in the steppe regions of Eastern Transbaykalia and Tuva, however.

On the American continent, strains having the P-41-positive marker were also discovered not just in Alaska and the northwestern territories of Canada but also in middle latitudes—in the provinces of Ontario and Quebec and in the state of New York,[17] i.e., at 50° south latitude and southward. Moreover, one of the strains isolated within Norway's territory reacted with P-41 MAbs.[19] Strains from Madagascar that have an antigen profile similar to that of strains from the Alaskan ground squirrel should evidently react with P-41 in an analogous manner. Several such strains have also spread to the Subarctic.[1,16,17]

Table 2. Information about Strains Isolated at Moderate Latitudes in the Former USSR That Reacted Positively With P-41 Monoclonal Antibody

Region Where Strain Was Isolated	Predominant Landform and Geographic Latitude	Source of Strain	No. Strains	Year Strain Isolated
Estonia and Minsk, Leningrad, Pskov, and Kaliningrad oblasts	Subtaiga forest and farmlands, about 58°N. lat	Man, dog, cat, cattle *V. vulves*, *M. meles*, *C. lupus*, *N. procyonoides*	40	1988-1991
Central Yakutia	Mountainous taiga, about 64°N. lat	*M. sibirica*	1	1991
Eastern Transbaykalia	Mountainous steppe, about 52°N. lat	*V. vulpes*, *V. corsae*	5	1977, 1980
Tuva	Semiarid land of intermontane trough, about 52° N. lat	*C. undulatus*	1	1983

Rabies virus with a positive reaction to P-41 MAbs has also been discovered in the head of a person who died as a result of hydrophobia. The female patient was bit on the back of the hand and shin by a hunting dog in the Kuninskiy Rayon of the Pskov Oblast on 9 February 1989. The dog, which had clinical symptoms of rabies, was killed 4 days later; however, no material from the animal was subjected to laboratory examination. The victim did not receive antirabies drugs and fell ill on 7 May 1989 after an incubation period of about 3 months. Her symptoms of disease, which included attacks of hydrophobia and agitation, were typical for rabies. The patient died on day 8 after the appearance of her initial symptoms. A second analogous case was also noted in the Pskov Oblast in 1991 after a wolf bite. Antirabies vaccination was performed but with failure to adhere to the instructions for its use.

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The infection occurred within the boundaries of the territory where circulation of strains of rabies virus reacting positively with P-41 MAb was discovered. This same virus was evidently linked to a case of hydrophobia as a result of infection from a fox in the vicinity of Leningrad in 1987, where the same types of strains were also isolated from wild animals. As is well known, cases of people contracting hydrophobia in the Subarctic have been recorded only rarely,[3,5-7,10,12,14] and in not one of the said cases was there any laboratory confirmation that the virus was of the Arctic variety.

Conclusions

1. The overwhelming majority of rabies virus strains circulating in the higher latitudes of the Russian Federation (north of 65-70° north latitude) reactive positively with P-41 MAbs.
2. Such strains are detected much more rarely and are propagated in the form of individual foci in the middle and southern latitudes of Eurasia. One of the largest foci includes the territories of Estonia and, evidently, the other Baltic states; part of Belarus; the Kaliningrad, Pskov, and Leningrad oblasts; and Finland.
3. It is possible that people may contract hydrophobia as a result of infection by strains having the P-41-positive marker.
4. The reaction with P-41 MAbs is an important but not exclusive sign of the "Arctic" variety of rabies virus. More precise identification requires the use of other MAbs.

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Features of Implementing Measures Against Against Rabies, Anthrax, and Foot and Mouth Disease Under Extreme Conditions

947C0549A Moscow VETERINARIYA in Russian No 8, Aug 94 pp 9-11

[Article by V.A. Sedov and B.A. Kruglikov]

[FBIS Abstract] Development/implementation of measures to prevent the spread of epizootic diseases is always difficult but is especially difficult under extreme conditions such as those existing as a result of natural disasters. Veterinary measures in areas in which a natural disaster has occurred are typically organized and implemented in two stages. The first stage entails providing first aid to injured animals and transporting cattle from the most heavily damaged farms to other areas of the republic. The second stage entails an assessment of the affected region's epizootic condition and development of emergency measures to prevent the development/spread of infectious diseases among animals and toxoinfections among people. Depending on the conditions existing in a given area, the two stages may be implemented simultaneously. The following are among the distinctive features/basic principles of the process of organizing/implementing antiepizootic measures under extreme conditions: lack of the conditions

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required for the normal work of veterinary specialists; need to implement an entire system of antiepizootic measures under field conditions (including organizing temporary residences in tents regardless of the time of year, creating conditions suitable for storing biologic preparations, creating veterinary teams of veterinary specialists residing in the disaster area and specialists brought into the region); lack of complete data regarding epizootic conditions of the rayon as a whole and those existing on individual farms and lack of exact dates when vaccinations were last administered); need to determine the sequence in which measures are implemented on the basis of information regarding the epizootic situation existing in a specific period, time of year, and set of meteorological conditions and information regarding the real threat of specific infectious diseases; need to implement all measures in accordance with standard veterinary practices; and unfeasibility of the use of common antiepizootic measures such as quarantine and isolation. The antiepizootic measures implemented in Armenia after the 1988 earthquake, which reflected these features/principles, proved successful in preventing widespread outbreaks of rabies, anthrax, and foot and mouth disease. Because the earthquake occurred in December, it was decided to delay vaccinating cattle against anthrax until spring. Trivalent GOA formol vaccine (A, O, C) (manufactured by the Shchelkovo Biological Combine) was used for mass immunization of cattle, goats, and sheep, and Aziya-1 foot and mouth disease vaccine was held in reserve. Rescue workers, veterinary specialists, and vehicles brought in from Uzbekistan (where foot and mouth disease was occurring among agricultural animals) were only allowed to work within the boundaries of the city of Leninakan. In areas neighboring affected rayons, all cattle, goats, and sheet were vaccinated, and cattle and sheep (except for those that had been immunized against foot and mouth disease 1-2 months before the earthquake) were revaccinated. To reduce the risk of rabies, teams of hunters waged a coordinated effort to kill roaming dogs. Mass vaccination of cattle, sheep, and horses against anthrax was conducted at the end of March 1989. These measures proved successful in preventing foot and mouth disease, rabies, and anthrax.

Evaluation of the Efficacy of 10-Year Use of Strain 55-VNIIVViM Vaccine Against Anthrax in Animals

947C0549B Moscow VETERINARIYA in Russian No 8, Aug 94 pp 11-15

[Article by I.A. Bakulov and V.A. Gavrilov, All-Russian Veterinary Virusology and Microbiology Scientific Research Institute]

[FBIS Abstract] Strain 55-VNIIVViM vaccine against anthrax was developed at the All-Russian Veterinary Virusology and Microbiology Scientific Research Institute [VNIIVViM] on the basis of the naturally attenuated acapsular spore-forming anthrax strain No. 55 that was isolated from pigs. Commercial production and use of strain 55-VNIIVViM began in 1984, and mass vaccination using the said strain began in 1986. From 1984 to 1992, anthrax vaccine from the strain 55-VNIIVViM was used to vaccinate a total of 636,245,585 head of cattle, sheep, goats, horses, pigs, reindeer, and camels. The efficacy of strain 55-VNIIVViM during the first 10 years of its use was evaluated on the basis of data from the Department of Veterinary Science of the Russian Federation Ministry of Agriculture and a survey of individuals at sites where strain 55-VNIIVViM was administered. The vaccine was evaluated positively in the 60 survey instruments returned from respondents in the Russian Federation. Respondents praised strain 55-VNIIVViM for its convenient dosing, the duration of the immunity it provided, its good tolerability (only a few cases of complications were reported), and the length of time for which it can be stored without loss of activity. An analysis of Ministry of Agriculture data for the period from 1979 through 1992 established that in all animals except pigs, use of strain 55-VNIIVViM was associated with a decrease in all indicators characterizing the intensity of the anthrax disease process to about half their values for the period before wide-scale use of the strain was initiated. The said complications were attributed not to problems with the vaccine's quality but rather to failure to follow published instructions regarding administration of the vaccine. It was in fact concluded that strict adherence to the instructions for administering the vaccine would reduce the number of complications to zero. Among the survey respondents' comments concerning suggestions for improving the anthrax vaccine were calls for reducing the number of doses per ampule to 20-50, specifying the amount of diluent required for a single dose of vaccine, and clarifying certain points in the instructions regarding its administration. Respondents also requested that researchers create associated preparations in which strain 55-VNIIVViM is a component. Several such preparations are now being developed. Research to further improve anthrax vaccines is also in progress. In December 1993, the Russian Federation Ministry of Agriculture's Scientific-Technical Council met to discuss the state of the art of vaccines based on strain 55-VNIIVViM. The council approved the VNIIVViM's work to create a new anthrax vaccine from strain 55 that is being readied for commercial production and wide-scale introduction into veterinary practice. It was recommended that anthrax vaccines be developed in various forms (lyophilized, liquid, and concentrated) and for various routes of administration (subcutaneous and intracutaneous using needleless injectors). It was also recommended that research to create associated vaccines and develop anthrax vaccine for oral use be continued and that a system to monitor the anthrax immunity of vaccinated animals be developed and instituted. Tables 2.

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Evaluation of Anthrax Immunity in Animals at Different Periods After Vaccination

947C0549C Moscow VETERINARIYA in Russian
No 8, Aug 94 pp 30-31

[Article by A.K. Galiullin, A.A. Fayzullin, and D.A. Adiyatullina, VNIVI (not further identified); UDC 619:576.807.7:591.2:615.371/.372]

[FBIS Abstract] A set of diagnosticums for immunoenzyme assay and indirect hemagglutination that were developed at the VNIVI (not further identified) in 1987-1990 have shown positive results in studies of antibody formation in laboratory animals vaccinated with anthrax vaccine. The said diagnosticums were tested in a study of laboratory animals' immunity to anthrax at different periods after vaccination. The studies were performed on rabbits in a laboratory devoted to the study of anthrax and on cattle and sheep that had been immunized with the vaccine 55-VNIIVViM and that were being raised on farms in the Republic of Tatarstan and in the Krasnodar Kray. The blood serum of a total of 2,761 rabbits was studied for the presence of antibodies in indirect hemagglutination and immunoenzyme assay 1, 2, 4, 5, 7, 9, 11, and 12 months after the rabbits had been vaccinated against anthrax. Consideration was given to the rabbits' age and number of times they had been immunized. To estimate the vaccinated rabbits' immunity, they were infected with the virulent strain Ch-7 in a dose of 10 LD_{50}. The antibody titers determined by using indirect hemagglutination and immunoenzyme assay were found to depend on the length of time after vaccination and the age and type of animal. In cows, the maximum antibody titer detected in indirect hemagglutination (144 +/- 14.2) was noted 5 months after the animals had been vaccinated. Thirty days after having been vaccinated, 83 percent of the cows reacted positively. By 5 months after the date of vaccination, 100 percent of the cows had a positive reaction. By 11 months after vaccination, the number of cows with a positive reaction had decreased to 66 percent. The antibody titer in young calves was 5.7 +/- 0.6 after 4 months and 7.3 +/- 1.6 after 7 months (with 36 percent of the young calves having a positive reaction). The fact that the percentages of mature cows reacting positively in the indirect hemagglutination and immunoenzyme assay were much higher than the percentages of young calves with positive reactions was attributed to the fact that the older cows had been vaccinated against Siberian ulcer numerous times throughout their lives. The antibody titer for sheep, as determined by indirect hemagglutination 2 months after vaccination, amounted to 45.5 +/- 10.0, whereas that determined by immunoenzyme assay (also at 2 months after vaccination) amounted to 61.0 +/- 8.9. After 11 months, the antibody titers determined for the sheep by indirect hemagglutination and immunoenzyme assay had decreased to 9.2 +/- 1.3 and 15.3 +/- 2.4, respectively. Between 72 and 79 percent of the sheep reacted positively in the indirect hemagglutination versus 73 to 80 percent in the immunoenzyme assay. The numbers of surviving animals were highest in those groups with the highest antibody titers. The diagnosticums tested made it possible to detect antibodies in the study animals' blood serum over the entire course of the study (12 months). Tables 2; references 12: 7 Russian, 5 Western.

MEDICINE AND PUBLIC HEALTH

Model of Response of Membrane Transport System to Variable Electric Field

947C0537A Moscow BIOFIZIKA in Russian
Vol 38 No 4, Jul-Aug 93 (manuscript received 25 Sep 92) pp 667-671

[Article by G. Yu. Riznichenko, T. Yu. Plyusnina, T. N. Vorobyeva, S. I. Aksenov, and G. M. Chernyakov, Biology Department, Moscow State University imeni M. V. Lomonosov; Army Medicine Academy, St. Petersburg]

[FBIS Abstract] This paper proposes a mathematical model of a nonlinear system of a transmembrane current in modulation of the parameter of the rate of ionic inflow to a membrane by means of a low intensity periodic electric field. The open system of membrane transport involves the inflow and outflow of H^+ and I^+ ions in the layer next to the membrane and their antiport. The results showed that the resonance frequency of the system belongs to a region of ultra-low frequencies. The simulation was performed for a system of K^+-H^+ antiport through a lipid bilayer membrane in the presence of nigericin. It was found that a nonlinear system of membrane transport may amplify the effect of a low intensity electric field. In conclusion, an external weak signal elicits significant changes in the concentrations of ions in the layer next to the membrane, which may affect metabolic processes due to movement of membrane-bound peripheral proteins into the cytoplasm. Figures 2; references 12: 9 Russian, 3 Western.

Enzymatic Reaction in External Electromagnetic Field

947C0537B Moscow BIOFIZIKA in Russian
Vol 38 No 4, Jul-Aug 93 (manuscript received 31 Mar 92) pp 619-626

[Article by A. V. Belousov, V. A. Kovarskiy, Ye. T. Merlin, and B. S. Yastrebov, Applied Physics Institute, Moldova Academy of Sciences, Kishinev]

[FBIS Abstract] This paper discusses the quasienergetic spectrum of an oxidation-reduction enzymatic reaction in an external electromagnetic field. The results showed that changes in the rates of enzymatic catalysis observed in the experiments that were caused by the external electromagnetic field may be explained within the framework of existing concepts of the effect of an electromagnetic field on the non-radiative passage of the electron. Figures 3; references 12: 10 Russian, 2 Western.

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Collective Properties of Mutual-Learned Neuron Networks in Information Field

947C0537C Moscow BIOFIZIKA in Russian Vol 38 No 4, Jul-Aug 93 (manuscript received 17 Nov 92) pp 727-735

[Article by A. Yu. Grosberg and N. V. Khrustova, Chemical Physics Institute imeni N. N. Semenov, Russian Academy of Sciences, Moscow]

[FBIS Abstract] The objective of this research was the numeric simulation of a system of neuron networks that communicate by transmission and associative recognition of signals and also to investigate the possibilities of self-organization of such a self-taught ensemble. All the networks have identical phasic distances of incoming and outgoing signals, and all networks interacted by transmitting signals. The results showed that system behavior depends on the value of the learning parameter. It was shown that the system of information exchange of the neuron networks, similar to the Eigen hypercycle, may be implemented using several methods and has a rather abundant set of properties. Figures 5; tables; references 23: 3 Russian, 20 Western.

Atraumatic Laser Scalpel

947C0553A St. Petersburg PISMA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 20 No 4, Feb 94 (manuscript received 7 Jan 94) pp 82-86

[Article by G.B. Altshuler, A.V. Yerofeyev, I.K. Ilyasov, and K.V. Prikhodka, Precision Mechanics and Optics Institute, Saint Petersburg; UDC 07;12]

[FBIS Abstract] The laser scalpel has become a common instrument in surgical practice. In most cases, however, it is far from certain that the laser radiation is being put to optimum use. The optimum situation would be one where the laser radiation inflicts the least amount of injury while achieving the speed required to remove or dissect tissue. Two simple criteria have been proposed for evaluating the optimality of laser destruction of tissue: $K = V_1/E$ (the ratio of the area of the removed tissue to the laser radiation energy expended to remove it) and $H = V_2/V_1$ (the ratio of the area of necrotic tissue to the area of removed tissue). Together, these two indicators provide a rough estimate of a laser scalpel's efficiency and quality. The effect of the temporal and spatial structure of laser radiation with a wavelength of 1.06 μm on on the characteristics of laser destruction of tissue (i.e., on K and H) was studied. It was demonstrated that using quasi-continuous-wave radiation (i.e., a partially pulsed mode of laser radiation) rather than the continuous-wave radiation that is conventionally used in laser scalpels based on a YAG:Nd^{3+} laser significantly improves the quality of the laser-inflicted wound. It was also demonstrated that laser radiation involving making contact with the tissue is superior to a "remote" mode, i.e., one not involving direct contact with the tissue, because the main tissue-destroying factor that must be considered in such cases is the thermal effect of the laser's tip. It was recommended that a laser scalpel's power be selecting by proceeding from the condition of the maximum permissible amount of trauma that can be inflicted by the laser procedure. A neodymium laser operating in a pulse-frequency modulation mode at a wavelength of 1.06 μm was thus concluded to be best for use as a laser scalpel even though it is less efficient than a laser operating in a continuous-wave mode. Figures 2.

Pharmaceutical Committee Notice No. 3 on Registration of Pharmaceuticals

947C0520A Kiev FARMATSEVTYCHNYY ZHURNAL in Ukrainian No 1, Jan-Feb 94 pp 82-98

[Article by Head, Pharmacological Committee, Ministry of Health of Ukraine, N.I. Sharykina under the "In Pharmacological Committee, Ministry of Health of Ukraine": "Notice No 3, Pharmacological Committee, Ministry of Health of Ukraine"; UDC 615.35:615.11]

[FBIS Translated Text] We are continuing to apprise professionals involved in issues of implementation of medicinal preparations with Pharmacological Committee requirements to registration of foreign medicinal preparations in Ukraine.

According to the current rules the scope of documents that must be presented depends on the preparation proposed for registration. They can be conventionally divided into the following groups:

1. A new original (generic) medicinal preparation or its first re-registration in Ukraine.
2. A medicinal preparation reproduced per company's license.
3. A medicinal preparation reproduced per own technology.
4. New medicinal forms (including those for children) of a previously registered preparation, as well as new indications and dosages.
5. A new original medicinal preparation that has not yet been registered anywhere and is in the stage of clinical testing in other countries.

The Pharmacological Committee presents a "List of Documents..." necessary for registration and re-registration of medicinal preparations of each of the above groups.

We are continuing publishing the list of foreign-made preparations that have been registered at the Pharmacological Committee of Ukraine (Tables 1 and 2) as of 11-20-93.

The Pharmacological Committee will continue publishing information regarding registration of medicinal preparations.

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List of Documents Necessary for Registration of New Original (Generic) Foreign Medicinal Preparations or Their First Re-Registration in Ukraine

1. A cover letter from the company addressed to Deputy Minister of Health of Ukraine and Head, Pharmacological Committee, Ministry of Health of Ukraine, with their resolutions.
2. An official Pharmacological Committee response to the company regarding results of the initial examination of the presented preparations with a Bureau of Registration visa.
3. An application for registration or re-registration of the preparation.
4. A document attesting to registration of the preparation in the country where it is manufactured.
5. A list of countries where the preparation has been registered.
6. A summary (summarized) certificate (resume) regarding the preparation, with information on medical, biological and clinical data (the original and translation).
7. A report on studies of pharmacological (specific) activity.
8. A report on studies of toxicity (acute, subacute, chronic).
9. A report on studies of specific toxicity types (carcinogenicity, mutagenicity, teratogenicity, embriotoxicity, allergenic and locally stimulating activity etc.).
10. A report on clinical testing; scientific papers.
11. Pharmacokinetic studies.
12. Technical standards documentation (TSD) in the original language, as well as in Ukrainian or Russian, with information on the composition of the preparation, and on methods to control quality and stability of the preparation, its biologically active substance and auxiliary substances used.
13. Instructions on medical applications (the original and translation).
14. The preparation quality control certificate (with an up to two years term of conducting analyses).
15. Copies of publications on the preparation manufactured by the company.
16. Summarized data on side effects of the preparation.
17. Samples (at least 5) of the preparation for each medicinal form and dosage.

List of Documents Necessary for Registration of Foreign Medicinal Preparations Manufactured Per License

1. A cover letter from the company addressed to Deputy Minister of Health of Ukraine and Head, Pharmacological Committee, Ministry of Health of Ukraine, with their resolutions.
2. An official Pharmacological Committee response to the company regarding results of the initial examination of the presented preparations with a Bureau of Registration visa.
3. An application for registration or re-registration of the preparation.
4. A document attesting to registration of the preparation in the country where it is made.
5. A list of countries where the preparation has been registered.
6. A summary (summarized) certificate (resume) regarding the preparation, with information on medical, biological and clinical data (the original and translation).
7. A report on studies of the pharmacological (specific) activity.
8. A report on studies of toxicity (acute, subacute, chronic).
9. A report on studies of specific toxicity types (carcinogenicity, mutagenicity, teratogenicity, embriotoxicity, allergenic and locally stimulating activity etc.).
10. A report on clinical testing; scientific papers.
11. Pharmacokinetic studies.
12. Technical standards documentation (TSD) in the original language, as well as in Ukrainian or Russian, with information on the composition of the preparation, and methods to control quality and stability of the preparation, its biologically active substance and auxiliary substances used.
13. Instructions on medical applications (the original and translation).
14. The preparation quality control certificate (with an up to two years term of conducting analyses).
15. Copies of publications on the preparation manufactured by the company.
16. Summarized data on side effects of the preparation.
17. Samples (at least 5) of the preparation for each medicinal form and dosage.
18. A document attesting that the company that has issued a license for manufacturing the preparation controls and is responsible for its quality.

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List of Documents Necessary for Registration of Foreign Medicinal Preparations Manufactured Per Own Technology

1. A cover letter from the company addressed to Deputy Minister of Health of Ukraine and Head, Pharmacological Committee, Ministry of Health of Ukraine, with their resolutions.
2. An official Pharmacological Committee response to the company regarding results of the initial examination of the presented preparations with a Bureau of Registration visa.
3. An application for registration or re-registration of the preparation.
4. A document attesting to registration of the preparation in the country where it is manufactured.
5. A list of countries where the preparation has been registered.
6. Materials of comparative biopharmaceutical, pharmacological, pharmacokinetic and clinical studies that prove that the reproduced preparation is identical to the original one (the original and translation).
7. Technical standards documentation (TSD) with information on the composition of the preparation, and on methods to control quality and stability of the preparation, its biologically active substance and auxiliary substances used (the original and translation).
8. Instructions on medical applications (the original and translation).
9. The preparation quality control certificate (with an up to two years term).
10. A document attesting that the product meets specifications of the original preparation manufacturer or of a generally accepted Pharmacopeia. 11. Samples (at least 5) of the preparation for each medicinal form and dosage.

List of Documents Necessary for Registration of New Medicinal Forms (Including Those for Children) of Previously Registered Preparation, As Well As New Indications or New Dosages

1. A cover letter from the company addressed to Deputy Minister of Health of Ukraine and Head, Pharmacological Committee, Ministry of Health of Ukraine, with their resolutions.
2. An official Pharmacological Committee response to the company regarding results of the initial examination of the presented preparations with a Bureau of Registration visa.
3. An application for registration or re-registration of the preparation.
4. A summary (summarized) certificate (resume) regarding the preparation, with information on medical, biological and clinical data (the original and translation).
5. Technical standards documentation (TSD) with information on the composition of the preparation, and on methods to control quality and stability of the preparation, its biologically active substance and auxiliary substances used (the original and translation).
6. Instructions on medical applications (the original and translation).
7. A clinical testing report.
8. A quality control certificate for the preparation (with an up to two years term of conducting analyses).
9. Copies of publications.
10. Samples (at least 5) of the preparation for each medicinal form and dosage.

List of Documents Necessary to Consider Question of Conducting Clinical Testing of New Original Medicinal Preparations That Have Not Yet Been Registered Anywhere and are in Stage of Clinical Testing in Other Countries

1. A cover letter from the company addressed to Deputy Minister of Health of Ukraine and Head, Pharmacological Committee, Ministry of Health of Ukraine, with their resolutions.
2. An official Pharmacological Committee response to the company regarding results of the initial examination of the presented preparations with a Bureau of Registration visa.
3. An application for clinical testing.
4. Technical standards documentation (TSD) with information on the composition of the preparation, and on methods to control quality and stability of the preparation, its biologically active substance and auxiliary substances used (the original and translation).
5. A report on studies of pharmacological (specific) activity (the original and translation).
6. A report on studies of toxicity (acute, subacute, chronic) (the original and translation).
7. A report on studies of specific toxicity types (carcinogenicity, mutagenicity, teratogenicity, embriotoxicity, allergenic and locally stimulating activity etc.) (the original and translation).
8. Pharmacokinetic studies.
9. A report on clinical testing with initial documentation (the original and translation).
10. A draft of the clinical testing program and copy of the contract between the company and clinical base.
11. Samples (at least 5) for each medicinal form and dosage.

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[Note. The article is accompanied by two tables:

Table 1. List of Foreign-Made Preparations That Have Passed Five-Year Re- Registration at Pharmacological Committee, Ministry of Health of Ukraine (as of 11-20-93) (32 preparations listed)

Table 2. List of Foreign-Made Preparations That Have Been Registered at Pharmacological Committee, Ministry of Health of Ukraine (as of 11-20-93) (102 preparations listed)].

Some Demographic Trends in Russian Federation

947C0493B Moscow ZDRAVOOKHRANENIYE ROSSIYSKOY FEDERATSII in Russian No 3, May-Jun 94 pp 30-33 (manuscript received 22 Oct 93)

[Article by I.N. Beselkova, Ye.V. Zemlyanova and Z.D. Silina: Moscow UDC 314(470)

[FBIS Abstract] The medico-demographic situation in Russia is characterized by a long-term reduction of birth rate, high mortality and irrational migration. The impact of migration was especially great in the 1980's. The transition to population decline was due not only to a reduced birth rate but also due to significant worsening of the health of the people and increasing mortality. The drop in birth rate was complicated by the crisis situation in the social and economic sphere coupled with political instability. The drop in birth rate increased t he percentage of old persons with the accompanying social-economic and medical consequences. The divorce rate affects this situation. The increasing number of births out of wedlock has increased child mortaliity. Prevalence of abortions, sexual excesses of many Russians and poor working conditions affect the health of future mothers. The epidemiological transition in the 20th century with the decrease of acute diseases, mostly from exogenous causes, and the increase of chronic diseases, mostly of e ndogenous etiology (heart disease and cancer) had signicant demographic impact. Decrease in life expectancy after 1965 was attributed almost exclusively to increased mortality from trauma and poisonings in middle age groups and diseases of the circulatory system. Dynamics of life expectancy depended on behavorial facators and improvements in public health. The effect of anti-alcohol measures on demographic trends was discussed. Life expectancy of Russians is 5-8 years less than that for persons in dev eloped countries. References 11 Russian

Social-Ecological Aspects of Reproductology in Regions Contaminated by Dioxins

947C0493A Moscow ZDRAVOOKHRANENIYE ROSSIYSKOY FEDERATSII in Russian No 3, May-Jun 94 pp 28-30 (manuscript received 14 Jul 93)

[Article by A. V. Shumulina; Samara Branch of NPO "Hygiene and Occupational Pathology"; Russian Federation State Commission of Sanitation and Epidemiological Inspection UDC 618.179-02:614.7/-07

[FBIS Abstract] A study of the global threat to the environment from dioxins and related compounds with emphasis on the danger to pregnant women, new-born babies and mothers and children under the age of one year described a study by the Institute of Experimental Meteorology conducted in Chapayevsk in 1991-1993. The study revealed the presence of these contaminants in drinking water, recycled water, soil, plants and in mothers milk. Most of the dioxins came from the sludge storage device at Chapayevsk Chemical Fertilizer Plant. Studies showed the technogenic nature of congenital defects in development of neonates in the region and gross disturbances of functions of the organism. Some fetuses revealed multiple macroanomalies. The high number of spontaneous abortions kept the number of congenital anomalies from being much higher. Many of these were caused by pollution of the environment by mutagens such as dioxins. The damage from dioxins and related compounds to the female organism and progeny begins before formation of the embryo and fetus due to damage to the sex cells. These findings showed the necessity of protection of women not only during gestation but also in the periovulatory period. References 5: 3 Russian; 2 Western.

Sanitary-Bacteriologic Aspects of Using Marine Culture of Mussels for Biologic Amelioration of the Marine Environment

947C0542A Kiev GIDROBIOLOGICHESKIY ZHURNAL in Russian Vol 30 No 1, Jan-Feb 94 (manuscript received 2 Dec 92) pp 44-53

[Article by I.A. Govorin, V.V. Adobovskiy, and V.N. Katkov, Odessa Branch, Southern Seas Biology Institute, Ukraine Academy of Sciences, and Market Problems and Economic-Ecologic Research Institute, Ukraine Academy of Sciences, Odessa; UDC [(594.124:579.68)+614](262.5)]

[FBIS Abstract] A study examined the possible role of mussel sea farming in the formation of the bacteriologic characteristics of the marine environment in an aquatory that has been damaged by high and virtually constant levels of municipal-domestic sewage containing large amounts of allochthonous microorganisms. The studies, which were conducted from April through October in 1989-1991, involved sanitary-bacteriologic monitoring of the sea water, the mollusks, and their biosediments in a region in which experimental sea farming units had been set up. The system of Rif experimental units consisted of 20 storm-resistant modular carriers located in a region of Cape Bolshoy Fontan (the Odessa shore) located 700 m offshore on a segment of sea floor 10-11 m deep. Each individual module was a structure consisting of nine rigid tubular collectors (measuring 5 m in length and 0.1 m in diameter) mounted vertically on a common 2 x 2-m base. The modular carriers were arranged in a chain at an average distance of 5 m from one another so as to form a line directed from the south-southwest to the east-northeast. The entire system of sea farming units occupied an area of sea floor of about 270 m^2, and about 1,620 m^3 water was located in the carriers. During the spring-summer period, a sharply stratified vertical two-layer water mass system formed. The upper layer (0-5 m below sea level) consisted of water with a temperature of 18-23°C

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and salinity of 13-15 parts per thousand [ppt], whereas the lower layer (2 to 3 m thick) consisted of water with a temperature of 8-13°C and salinity of 15-17.5 ppt. The mussels' biomass fluctuated with the seasons and averaged 838 +/- 190 kg as calculated for the entire bearing surface of one module as a whole. At 5 and 10 m below sea level, the mussels' biomass averaged 172 +/- 33 and 86 +/- 23 kg per running meter of carrier, respectively. A series of regression equations were derived, and statistical models were constructed that described the relationship between the efficiency of the biologic amelioration process and various oceanographic factors. The sea water that had passed through Rif sea farming units was found to have undergone an observable decrease in the levels of bacteria disseminated in it. The reduction in bacterial levels averaged 44 percent in the case of heterotrophic bacteria and 44-48 percent in the case of bacteria of the colon bacillus group. The effectiveness of the biologic amelioration process occurring during cultivation of the mussels was found to be influenced by the starting level of the water's bacterial contamination and by the following oceanographic factors: the velocity and direction of currents at different sea levels, the water's salt content, water temperature, and the degree to which the water was saturated with dissolved oxygen. It was concluded that cultivating mussels undoubtedly plays a positive role in the formation of the marine environment's sanitary-bacteriologic characteristics and that such mollusk cultivation may be used as a biofilter of allochthonous microorganisms passing through coastal aquatories. The close link between the biologic amelioration process and biotic and abiotic conditions of the marine environment that was discovered during the course of the study was deemed a topic worthy of additional in-depth research to identify those factors limiting the efficiency of the biologic amelioration process in specific aquatories. The regression equations were recommended for use as a basis of prognostic estimates of the operating efficiency of mussel biofilters in waters with different levels of bacterial contamination and different oceanographic characteristics. Tables 4; references 16: 14 Russian, 2 Western.

Condition of Bream Breeders and Survival Rate of Their Offspring in the Zone of the Chernobyl Accident

947C0542B Kiev GIDROBIOLOGICHESKIY ZHURNAL in Russian Vol 30 No 1, Jan-Feb 94 (manuscript received 11 Oct 92) pp 71-77

[Article by N.Yu. Yevtushenko, T.D. Malyzheva, V.P. Bilko, and N.V. Arutyunova, Hydrobiology Institute, Ukraine Academy of Sciences, Kiev; UDC 597.554.3-11(28)]

[FBIS Abstract] A study examined the condition of bream *Abramis brama* L. breeders and the survival rate of their offspring in the zone affected by the accident at the Chernobyl Nuclear Power Plant. The bream were collected in spring 1991-1992 during their spawning period from the Dniepr portion of the Teremtsovskiy meadow at the mouth of the Pripyat River. Fish caught at the same period but in less contaminated sections of the Kiev water reservoir (near Kosachevka) and in the Kremenchut water reservoir served as controls. Included in the studies were 48 sexually mature females (5 to 6 years old). In addition to the breeders, researchers also examined a total of 5,028 fish eggs collected from spawning sites in the aforementioned areas. The bream's condition was evaluated on the basis of tissue protein and lipid levels, analysis of their lipid fractions, amount of free fatty acids, intensity of lipid peroxide oxidation, and indicators of antioxidant activity. Total protein was determined as per the Lowry method, total lipids were determined by the spectrophotometric method, fractional analysis of the lipids was performed by thin-layer chromatography of pure lipids extracted from tissues by the Folch method, the intensity of lipid peroxide oxidation was determined on the basis of the malonic dialdehyde level, and antioxidant activity was judged on the basis of the amount of phospholipids as determined by the hydrooxamate method. The results of the experiments were subjected to an analysis of variance. No significant differences were found between the levels of total protein in the organs of the controls caught in 1991 and those of the bream caught in the same year but near the site of the Chernobyl accident. The bream caught near the accident site in 1991 were found to have low levels of lipids in their livers, oocytes, gills, and muscles. The lipid levels of the bream caught near the Chernobyl accident site in 1992, on the other hand, were significantly higher than those of their counterparts caught a year earlier and were virtually as high as those of the controls caught in 1992. The depressed lipid levels of the bream caught near the Chernobyl accident site in 1991 were attributed to the food available to them at that point in time. The bream caught near the Chernobyl accident site in 1992 were found to have significantly higher total protein levels in their livers and oocytes than the controls did. Various tissues of the bream caught near the Chernobyl plant were found to have accumulated triacylglycerin and cholesterol esters that were functioning as reserve lipids. The said accumulations were particularly noticeable in the gills of the bream. The gills and muscles of the bream living near the Chernobyl plant were also found to contain significantly lower levels of malonic dialdehyde than did the corresponding tissues of the controls. The bream eggs studied in 1992 were determined to have a survival rate of 98.7 percent (which was similar to the 98.4 percent survival rate of bream eggs from a nearby area that were studied in 1987). The survival rate of the bream embryos studied remained approximately the same at all stages of embryonic development. It was concluded that the adaptation capabilities of bream breeders living in the vicinity of the Chernobyl accident site are such that despite certain fluctuations in their metabolic indicators, they are able to produce offspring with a high survival rate. The possibility that the study results reflect a hormesis effect of low levels of radiation inherent to the sites where bream spawn was not ruled out. The question of whether such an effect is only characteristic of bream or whether it holds true for other species of fish was left for future studies. Tables 5; references 13: 11 Russian, 2 Western.

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Investigation of the Radioecological Situation in the Volga River's Ecosystem

947C0542C Kiev GIDROBIOLOGICHESKIY ZHURNAL in Russian Vol 30 No 1, Jan-Feb 94 (manuscript received 15 Jan 93) pp 78-92

[Article by I.V. Pankov, Ye.N. Volkova, A.V. Alekseyenko, and M.I. Kuzmenko, Hydrobiology Institute, Ukraine Academy of Sciences, Kiev; UDC 577.34: 574.5(282.247.41)]

[FBIS Abstract] A study examined the radioecological situation existing in the ecosystem of the Volga River. Specimens of the river's aquatic life (water flora, mollusks, fish, and amphibians) were collected manually as well as by scraping, dragging, and using bottom grabs and nets. Samples were collected at a total of 13 sampling stations located along the river from its mouth to its headwaters. Suspensions and bottom sediments were carefully rinsed off of the specimens at the sampling sites. Radiochemical methods were used to analyze their levels of strontium 90, cesium 134, and cesium 137. The measurement error did not exceed 30 percent. The specific radioactivity of the river's filtered water and that of its bottom sediments were also measured. The studies confirmed that radionuclides released as a result of the accident at the Chernobyl Nuclear Power Plant dictated the level of technogenic radioactive contamination of the Volga's water, the upper layer of its bottom sediments, and its higher aquatic plants. This conclusion was confirmed by the radionuclide profile of the analyzed samples and by the ratios of cesium 137, ruthenium 106, and antimony 125 to cesium 134. The levels of strontium 90 and cesium radionuclides in the abiotic and biotic components of the Volga's ecosystem varied widely depending on the sampling site and the species of aquatic life sampled. On average for all of the groups of water organisms studied, strontium 90 accounted for more than 50 percent of the total γ- and β-radioactivity in higher plants (52 percent), mollusks (51 percent), and amphibians (61 percent), whereas cesium radionuclides accounted for most of the total γ- and β-radioactivity of phytobenthos and phytoplankton (>90 percent), green algaes (72 percent), and fish (67 percent). For individual species of the aquatic life analyzed, however, the contribution of the various radionuclides to total body radioactivity varied rather widely. The impact of the Chernobyl accident on the formation of the radioecological situation existing in the Volga River was also confirmed by a comparison of the study data with the results of studies of the radioactive contamination of the components of the biota of the Dniepr River before the accident (1978-1984). Under the conditions of global fallout of radionuclides from the atmosphere prior to 1986, strontium 90 dominated in most life-forms studied, whereas cesium radionuclides dominated in the Volga River in 1988. Regardless of the conditions considered, however, the level of radioactive contamination of mollusks was dictated by strontium 90, whereas that of fish was dictated by cesium radionuclides. An analysis of the coefficients of the radionuclide accumulation from water [K_w] and from bottom sediments [K_{bs}] established that K_w increased from the Volga's mouth to its headwaters. K_{bs}, which represents the ratio of the specific radioactivity of an aquatic life-form to the specific radioactivity of bottom sediments, fluctuated widely (from 0.08 to 7.30) from one aquatic life-form to another and depended on both the ecological group and the specific species. The highest values of K_{bs} for cesium 134 + cesium 137 were found for phytobenthos. The values of both K_w and K_{bs} were highest in life-forms on the lower end of the evolutionary chain and decreased regularly in animals located progressively higher along the chain. The coefficients of radionuclide transfer [K_{tr}] along trophic chains in the Volga's ecosystem were also calculated. In the case of strontium 90, the values of K_{tr} calculated for transfer between lower to higher links in the trophic chain never exceeded 1, which is to say that the level of strontium 90 decreased with movement up both the trophic and evolutionary chains. It was concluded that the coefficients K_w, K_{bs}, and K_{tr} can serve as base coefficients in a radioecological monitoring system and that such a system should be created for continued radioecological monitoring of the Volga River. Figures 6, tables 9; references 7 (Russian).

Using Model-Maps To Evaluate the Quality of Western Bug and Dniester Rivers

947C0542D Kiev GIDROBIOLOGICHESKIY ZHURNAL in Russian Vol 30 No 1, Jan-Feb 94 (manuscript received 28 Apr 92) pp 93-98

[Article by I.S. Khamar; UDC 574.63(282.4)]

[FBIS Abstract] Modified model-maps (diagrams) developed and described by by I.V. Grip et al. in a 1991 publication were used to examine the quality of the surface waters of the Western Bug and Dniester rivers and the rivers of their basins. The model-map on which the analysis was based is a circular diagram consisting of five concentric circles of different diameters. The five circles correspond to boundaries of five water quality classes (it was determined that representing a sixth class would make no sense). The diagram has nine radii corresponding to normed sanitary-hygiene characteristics. The radii divide the area of the circles into equal sectors. Each radius is an axis along which values of a given hydrochemical indicator (i.e., classifier of one of the five water quality classes) are plotted. The following sanitary-ecological indicators were considered:

- amount of dissolved oxygen (an indicator of the water reservoir's productivity);
- level of chlorides and sulfates characterizing the salt background and washoff of mineral fertilizers from the rivers' catchment areas or acidification of the waters as a result of atmospheric precipitation;
- level of biogenic compounds (various forms of nitrogen) indicating the sources, nature, and condition of the sewage dumped into the rivers;
- level of petroleum products and heavy metal ions (an indicator of industrial pollution);
- biochemical oxygen demand (an indicator characterizing the intensity of self-purification processes).

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The analysis revealed that the water quality of the rivers studied depends largely on the location of industrial discharge of potential pollutants. The analysis results were consistent with published data from previous studies. The observations of the Western Bug established "peaks" of petroleum products and ammonia, nitrate, and nitrite nitrogen in winter and "peaks" of ammonia nitrogen in summer. Overall, the waters of the second through fourth sections of the Western Bug were classified as belonging to the fourth quality class (which corresponds to an α-mesosaprobic zone) in winter and to the third quality class (a β-mesosaprobic zone) in summer. The waters of the first and fifth sections of the Western Bug were classified as belonging to the third quality class in winter and to the second (an oligosaprobic zone) in summer. In the case of the Dniester, the main hydrochemical characteristics affecting water quality were the levels of ammonia and nitrite nitrogen. The various sections of the Dniester were classified as being β- or α-mesosaprobic zones. Figures 2; references 5 (Russian).

Comprehensive Hygienic Studies in Industrial Arctic and Prospects

947C0505A Moscow VESTNIK ROSSIYSKOY AKADEMII MEDITSINCKIKH NAUK in Russian No 7, Jul 94 pp 26-30 (manuscript received 28 Dec 93)

[Article by A. P. Shitskova and A.I. Potapov, Moscow Scientific Research Institute of Hygiene imeni F. F. Erisman, State Committee Sanitary and Epidemiology Inspection of Russia, Moscow UDC 614.7-07:001.5]

[FBIS Abstract] Mastery of the Far North is continuing with high migration rates, urbanization and environmental changes with only the extreme climatic conditions remaining unchanged. Hygienic research has focused on new methodological approaches to the study of the complex effect of ecological factors and social-hygienic problems on the people's health under present conditions of life in the Far North. The hygienic prognosis was not favorable in judging prospects of improving the state of the environment nor in social-hygienic questions. Emphasis has been placed on early diagnosis of the most prevalent diseases under the effect of production factors and the environment and on assessment of effective methods of prophylaxis and treatment of occupational diseases. The biological importance of the low humidity in the Arctic on heat exchange in man, in the redistribution of body fluids and pronounced activation of water exchange and energy exchange was discussed. Study of occupational pathology emphasized the study of pathogenesis and clinical course of vibration sickness. Discussion of the worsening envionmental pollution emphasized the situation in Norilsk. Other problems discussed include optimization of water use and water quality in the Far North, significance of population increase, morbidity in children and the effect of prolonged cold. Recommendations for improving further studies on these subjects were made. References 15 Russian

Stat of Health of School-Age Children in Indu ial and Rural Areas of Western Siberia

947C0505B Moscow VESTNIK ROSSIYSKOY AKADEMII MEDITSINCKIKH NAUK in Russian No 7, July 94 pp 31-32 (manuscript received 2 Aug 1993)

[Article by A.Ya. Polyakov and K.P. Petrunicheva, Novosibirsk Branch HPO "Hygiene and Occupational Pathology" UDC 616-053.2:312-6]

[FBIS Abstract] Physicians of many specialties, examining school-age children living in rural and urban areas in Western Siberia, found that more than 90 percent of these children had chronic diseases or functional deviations of differ ent systems of the organism. Atmospheric pollution proved to more more harmful to children in urban areas. No children were found to be in excellent health. Measures recommended for improving the situation included: monitoring the state of health of base contingents of children in different regions of Siberia, development and introduction of active sanitation work with children at risk and development of the methodology and improvement of methods of finding potential health problems in these children. References 4 Russian.

Sociohygienic Problems of Morbidity of Children and Infant Mortality in Omsk

947C0505C Moscow VESTNIK ROSSIYSKOY AKADEMII MEDITSINCKIKH NAUK in Russian No 7, Jul 94 pp 33-34 (manuscript received 2 Aug 93)

[Article by S.G. Reznikov, V.G. Lopushanskiy, A.P. Denisov and O.P. Goleva UDC 313.13+312.1/-053.3-07]

[FBIS Abstract] A long (almost 20 years) study of child morbidity and infant mortality in Omsk showed that the morbidity of young children in Omsk significantly exceeded child morbidity found in other regions of the country. Respiratory diseases ranked first in overall morbidity. Unfavorable biological, medical and social factors led to high incidence of acute forms of respiratory diseases and this, in turn, led to high incidence of non-specific lung disease. The poor ecological sitiuation in Omsk is one of the leading factors in early chidlhood morbidity. Six general factors influencing neonatal mortality and seven factors influencing post-natal mortality were listed and discussed briefly. Medical assistance has decreased childhood mortality and morbidity in Omsk. Chronic nonspecific lung disease in children from infancy to the age of two years was attributed to the large-scale petrochemcil works in the area. Further decrease in infant mortality requires solution of many problems associated with protection of mothers and children. Improvement of observation of pregnant women and children was recommended. References 2 Russian.

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New Aspects of Ecology of Extra-Organism Populations of Pathogenic Microorganisms

947C0505D Moscow VESTNIK ROSSIYSKOY AKADEMII MEDITSINCKIKH NAUK in Russian No 7, Jul 94 pp 45-49 (manuscript received 2 Aug 93)

[Article by G.P. Samov, Scientific Research Institute of Microbiology Siberian Department Russian Academy of Medical Sciences, Vladivostok UDC 579.26]

[FBIS Abstract] The author described and discussed his studies of pathogenic microorganisms and saprophytes and their inter-transitional forms. He showed, for the first time, that the pathogenic bacteria studied are chemoorganotropic (heterotropic) when found in the body of warm-blooded animals and man and chemolithoautotropic (autotropic) when inhabiting objects in the environment. The extremely wide range of their metabolic plasticity ensures the duality of their saprophytic and parasitic nature. The studies opened new perspectives in the ecology of pathogenic bacteria, confirmed the great commonality of the biochemical strategy of pathogenic and non-pathogenic bacteria, indicating the smoothness of the boundaries between saprophytism and parasitism and the smoothness of transition between these phenomena. These newly discovered facts show the need for study of extra-organism populations of pathogenic microorganisms from broad biological positions with use of population-ecological and molecular-genetic approaches to the solution of basic and applied aspects of this new problem. References 21 Russian.

Duma Ecology Chairman Reviews Health Effects of Orenburg Nuclear Tests

947C0518A Moscow 1ST QUARTER 93 GOSKOMSTAT STATS in Russian 14 Sep 94 p 1

[Article: "Was No One Forgotten? Was Nothing Forgotten?"]

[FBIS Translated Text] A monstrous experiment, the equal of which does not exist in world history, was conducted in the territory of Orenburg Oblast on 14 September 1954. Even the terrible tragedy of the Japanese cities of Hiroshima and Nagasaki, which were subjected to atomic bombing, cannot be compared with what happened in our country 40 years ago. In August 1945 a state, which was in a state of war with Japan, set off atomic bomb explosions. However, in Orenburg Oblast atomic weapons were tested on our own people. A total of 44,000 soldiers participated in tests, which maximally approximated combat operations. Fewer than 1,000 of them are alive today. In official documents they are called veterans of special risk subunits. However, journalists have aptly nicknamed them "atomic soldiers."

The following is written on the obelisk in the epicenter of the Totsk explosion: "For Those Who Scorned Danger and Performed Their Military Duty for the Sake of the Homeland's Defense Power."

To be sure, this sounds beautiful. However, is this so?

This is what Tamara Zlotnikova, deputy chairman of the Committee on Ecology, deputy of the State Duma from the 132d Orenburg Electoral District, thinks about this:

I cannot agree that these young lads, as well as thousands and thousands of peaceful residents who departed from life early, scorned danger. They simply were not aware of it. In essence, the state betrayed them, leaving them face to face with their trouble, with their tragedy.

It is well known that "atomic soldiers" gave a signed statement on a silence of 25 years and the divulging of the secret posed the threat of 15-year imprisonment. Almost all "atomic soldiers" departed from life with this terrible secret and never lived to see its disclosure, compassion, real social protection, and concrete help.

It is also known that the power of the Totsk bomb—20 kilotons—was similar to that of the Japanese explosions (16 and 21 kilotons) known all over the world for their monstrous consequences, while the height of the Orenburg air explosion was 300 meters, that is, twice as low as that of the explosions in Hiroshima and Nagasaki.

To this day the Japanese Government annually spends 145 billion yen, which amounts to about 3 trillion rubles, on the elimination of the consequences of those explosions (that is, on support, medical services, and social protection for bombing victims). In our country literally not a single kopeck is allocated for this.

The tragedy of Orenburg Oblast is not a sealed secret. "Ural Hiroshima," "Report From the Day of Hell," and "Repetition of the Apocalypse"—these are only some titles of articles published in central publications. Having collected and studied in the last few years several volumes of materials on Totsk experiments, I can state that there are no journalistic exaggerations here.

The tragedy of Orenburg Oblast is that, in addition to "atomic soldiers," our oblast's peaceful population, which did know about and did not suspect the terrible consequences of this monstrous experiment, became the victim of this military experiment and, in essence, genocide.

Not by chance do the oblast population's health indicators differ sharply in the specific sick rate from Russian ones: For example, during the period from 1950 through 1990 the increase in oncological diseases was 2.5- to 4-fold higher than throughout Russia and in neighboring Bashkortostan and Tatarstan, where the situation is far from satisfactory. In Orenburg Oblast from 1970 through 1990 mortality due to malignant diseases increased almost five-fold, which greatly exceeds average Russian indicators.

An analysis of the medico-demographic situation in rayons of Orenburg Oblast subjected to the effect of the Totsk explosion has shown that radiation induced pathology (oncomorbidity, congenital anomalies, and pathology of lymphoid and hematopoietic tissues) greatly exceeds similar indicators throughout Russia. In the region of the Totsk Proving Ground from 1963 through 1992 the number of children with congenital anomalies increased

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fivefold. The state of endocrine and immune systems in children causes special alarm.

It should be noted that all the previously obtained results concerning the consequences of the nuclear explosion did not take the most serious factor into consideration: Most of the Soviet-German tests of chemical weapons were conducted on the Totsk Proving Ground from 1926 through 1933. (Long-term tests of all types of chemical attacks, including air, ground, and with the use of mustard gas and, presumably, a number of other toxic agents, were "Tomk" objectives). As the archive data of the Ministry of Defense indicate, subsequently tests were conducted by the Soviet side.

Furthermore, in the oblast territory and near its borders during the period from 1974 through 1990 a total of 22 technical underground explosions were set off.

According to the data of the Ministry of Defense, the proving ground of the Main Missile and Artillery Administration in Orenburg Oblast causes great misgivings. The search for and collection of fragments of radioactive materials scattered and mixed with the soil is the basic problem here. The places of their burial and those responsible for the execution of work have not been determined. The status of this radioactive waste is not clear.

All this aggravates the ecological situation, which is extremely unsatisfactory as it is, and the state of health of Orenburg Oblast's residents, while inactivity on the part of the authorities builds up social tension among the oblast population.

There are other data on health anomalies, which point to the need for a thorough study of the consequences of chemical and nuclear tests and of peaceful explosions in the territory of Orenburg Oblast, as well as for the adoption of a system of measures to eliminate their consequences. The measures implemented by the oblast administration and by the State Committee on Civil Defense, Emergency Situations, and Recovery From Natural Disasters are ineffective and under conditions of their extremely insufficient financing do not ensure the solution of the problem concerning the elimination of the consequences of nuclear explosions and of other military tests in the oblast territory.

We know that Russia's President offered his apologies to the population of neighboring states for the actions of his predecessors. However, no one as yet has apologized to the population of Orenburg Oblast, which at the will of the state became the object of chemical and nuclear experiments. Orenburg Oblast, which was the victim, received assistance neither from communist nor from democratic authorities. Nevertheless, even today it is in dire need of real, substantial assistance—moral, medical, and social.

PHARMACOLOGY AND PHYSIOLOGY

Study of the Inactivation of Free and Liposome-Encapsulated Aminoglycosides by Enzymes of Resistant Bacterial Strains

947C0559A Moscow ANTIBIOTIKI I KHIMIOTERAPIYA in Russian Vol 38 No 8-9, Aug-Sep 93 (manuscript received 22 Jun 93) pp 26-29

[Article by I.V. Belyavskaya, N.S. Gryaznova, V.I. Afonin, R.M. Petyushenko, Yu.O. Sazykin, and S.M. Navashin, Antibiotics State Sceintific Center, Moscow; UDC 579.222]

[FBIS Abstract] A study examined the inactivation of free and liposome-encapsulated aminoglycosides by enzymes of resistant bacterial strains. Liposome-encapsulated streptomycin sulfate, kanamycin sulfate, neomycin sulfate, paromomycin, gentamicin sulfate, sisomicin sulfate, dibekacin, and amikacin sulfate were prepared by the continuous detergent dialysis method in a Loposomat (manufactured by Dianorm, Germany). The amount of antibiotics in the liposomes was determined by using the appropriate test microorganisms and the method of diffusion into agar. The acellular enzyme preparations used to inactivate the aminoglycosides were obtained by using cells of *Escherichia coli* 107 and *Salmonella oranienburg* 1376. The free and liposome-encapsulated aminoglycosides were inactivated in systems that had been found to be optimum for phosphorylation and adenylation and that contained adenosine triphosphate [ATP] (10 mg), $NaHCO_3$ (10 mg), and either free antibiotic (100 μg) or a liposomal preparation of the respective antibiotic (0.5 ml), an enzyme preparation (0.1-0.2 ml in the case of phosphorylation and 0.2-0.4 ml in the case of adenylation), and buffer (Tris, $MgCl_2$, KCl, and 2-mercaptoethanol). Two mixtures not containing ATP or $NaHCO_3$ and not containing any enzyme preparation served as controls. The mixtures were incubated for 1, 3, and 18 hours at 37°C. Amounts of inactivated antibiotic were determined by microbioloigc titration. Entrapment levels proved to be higher in the cases of paromomycin, gentamicin, and sisomicin than in the cases of the other antiobotics studied. No inactivation of liposome-encapsulated paromomycin was observed even after it had been incubated in the presence of an acellular preparation of 3'-1-phosphotransferase from *E. coli* 107 for 1 hour. Free paromomycin incubated under the same conditions in the presence of the enzyme was 50 percent inactivated. Inactivation of paromomycin was still not detected even after 3 hours of incubation in the presence of 3'-1-phosphotransferase. The liposome-encapsulated paromomycin retained about 50 percent of its activity even after 18 hours of incubation in the presence of the enzyme. Inactivation of gentamicin by an acellular preparation of 2"-adenylyltransferase obtained from *S. oranienburg* 1376 was also markedly decreased when it was in liposome-encapsulated form. Liposome encapsulation thus proved effective in preventing (in cases of short-term incubation) or significantly reducing (in cases of lengthy incubation) inactivation by a cellular preparations of enzymes of resistant bacterial strains. Figures 2, table 1; references 6: 4 Russian, 2 Western.

Study of the Properties of the Rif^R-Population of Anthrax Bacillus

947C0559B Moscow ANTIBIOTIKI I KHIMIOTERAPIYA in Russian Vol 38 No 8-9, Aug-Sep 93 (manuscript received 30 Jan 92) pp 34-38

[Article by A.P. Pomerantsev, L.V. Sukovatova, and L.I. Marinin, Applied Microbiology Scientific Research Institute, Obolensk, Moscow Oblast; UDC 616.34:615.281]

[FBIS Abstract] Many microorganisms quickly develop immunity to rifampicin. Rifampicin-resistant varieties of

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anthrax microbe have been reported to exist among clinical isolates of *Bacillus anthracis*; however, no data regarding their incidence or properties are available. A study of the properties of the rifampicin-resistant [Rif^R] population of anthrax bacillus was therefore conducted. The vaccine strains of anthrax microbe STI-1 and Sterne and the virulent strain Ch-7 were used in the studies. Rifampicin's antibacterial activity was determined by the method of successive series of dilutions of preparations in dense nutrient media. The frequency of the formation of spontaneous Rif^R mutants of the study strains was determined in selective media containing antibiotics in concentrations from 10 to 30 μg/U. The heterogeneity of the rifampicin-resistant population of the strain Ch-7 with respect to the level of resistance to the preparation was studied by seeding material prepared from isolated colonies on the surface of agar containing antibiotics in concentrations of 0.25 to 1,024 μg/ml. The toxicity of the study strains was controlled on the basis of their ability to induce edema in laboratory animals. Their capsule formation capability was determined according to Chu's method, and their spore formation was determined by seeding them onto dense media and culturing them at 30°C for 3-20 days. The virulence of the starting strains and Rif^R mutants was determined on the basis of their median lethal concentration in nonpedigree white mice weighing 18-20 g each. Formation of spontaneous Rif^R in the three anthrax strains studied was determined to occur at a rate of 10^{-8} per colony-forming unit. The mutants were found to possess varying levels of rifampicin resistance, with their minimal inhibitory concentrations ranging from 16 to 512 μg/ml. Clones of the Rif^R population of the virulent strain Ch-7 were found to be heterogeneous from the standpoint of the morphological properties of its colonies and cells, ability to synthesize toxin and capsules, and spore formation and virulence. The heterogeneity discovered was not correlated with the level of clones' resistance to rifampicin. Rifampicin was discovered to stimulate *B. anthracis* cells' loss of toxin, capsule, and spore formation. Among the Rif^R population, researchers found strains that retained their virulence both for intact animals and for animals treated with rifampicin. The Rif^R mutation in *B. anthracis* was not found to result in cross-resistance to penicillins, cephalosporins, tetracyclines, aminoglycosides, macrolides, or chloramphenicol. Tables 2; references 21: 10 Russian, 11 Western.

Sensitivity of Typhoid Bacteria Isolated From Patients in 1990 to Antibacterial Preparations and to Phage-Type Pattern

947C0559C Moscow ANTIBIOTIKI I KHIMIOTERAPIYA in Russian Vol 38 No 8-9, Aug-Sep 93 (manuscript received 5 Nov 92) pp 39-41

[Article by Yu.P. Solodovnikov and Ye.Yu. Novoselova, Epidemiology Central Scientific Research Institute; UDC 616.34-008.87:615.281]

[FBIS Abstract] A study examined the antibiotic sensitivity of typhoid cultures isolated in the territory of the former Soviet Union in 1990. The relative importance of circulating antibiotic-resistant strains of *Salmonella typhi* was determined, and the spectra and levels of their resistance and phage-type pattern were studied. Fecal and blood cultures of *S. typhi* isolated from typhoid patients and carriers in the following locations were studied: Moscow; Moscow Oblast; Kazakhstan; Novosibirsk; Gomel Oblast; Minsk; Lvov; Chernigov; Sumy, Kirovograd, Kherson, Magadan, and Leningrad oblasts; Ryazan; and Armenia. Also studied were three *S. typhi* strains obtained from the Live Culture Museum of the Indian National Institute of Cholera and Intestinal Infections in Calcutta. In all, 94 cultures isolated in the former USSR and 3 Indian strains were studied. The disk-diffusion method was used to determine the cultures' sensitivity to the following groups of antibiotics: penicillins, chloramphenicol, tetracyclines, polypeptides, rifampicin, and aminoglycosides. As a control measure, tests involving *Escherichia coli* ATCC 25922 were conducted in parallel with each of the tests conducted during the study. Commercial sets of concentrated phagolysates of typhoid bacteria (44 "standard" phagolysates) manufactured by the Bakteriofag Scientific Production Association were used for phage titration of the cultures. A total of 94 culture titrations were performed. The *S. typhi* cultures studied manifested high sensitivity to the following drugs currently used to treat typhoid patients: ampicillin (73.4 percent); kanamycin (97.9 percent); oxytetracycline (84 percent); tetracycline (94.7 percent); doxycycline (94.7 percent); streptomycin (72.3 percent); and nalidixic acid (86.2 percent). The strains were not highly sensitive to polymyxin B, gentamicin, or rifampicin, however. All of the strains isolated from the territory of the former USSR were sensitive to chloramphenicol, whereas the three Indian strains were resistant to it. No significant differences between the antibiotic sensitivities of the *S. typhi* isolated from blood cultures and those isolated from fecal cultures were discovered. Most of the isolates were of the phage types A_1 (57.5 percent) or B_1 (30.8 percent). No correlation between the isolates' phage types and antibiotic resistance was found. Tables 2; references 3: 1 Russian, 2 Western.

Efficacy of Doxycycline With Experimentally Induced Plague

947C0559D Moscow ANTIBIOTIKI I KHIMIOTERAPIYA in Russian Vol 38 No 8-9, Aug-Sep 93 (manuscript received 28 Jun 91) pp 48-50

[Article by L.N. Makarovskaya, A.I. Shcherbanyuk, V.V. Ryzhkova, and T.B. Sorokina, Antiplague Scientific Research Institute, Rostov-na-Donu; UDC 616.98:579.843.94]

[FBIS Abstract] The efficacies of doxycycline and tetracycline were compared, as were the efficacies of oral and injectable forms of doxycycline in the prophylaxis and treatment of experimentally induced plague in white mice. The efficacies of doxycycline and tetracycline that had been produced in Russia were compared in in vitro studies on 50 strains of plague microbe of natural origin that had been obtained from the Live Cultures Museum of the

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Antiplague Institute in Rostov-na-Donu. The minimal inhibitory concentration [MIC] of each antibiotic was determined in dense nutrient medium (pH 7.2) with two-fold dilution of the antibiotics. The efficacy of doxycycline and tetracycline in experimentally induced plague was studied in a group of nonpedigree white mice that weighed 18 to 20 g each and that had been injected with a dose of 10,000 microbial cells (1,250 times the median lethal concentration) that had been obtained form a 1-day culture of *Yersinia pestis* 231. For prophylactic purposes, the antibiotics were administered 6 hours after the mice had been injected. For therapeutic purposes, they were administered 24 hours after the mice had been injected with the *Y. pestis* cells. The antibiotics were administered 2, 3, 5, 7, or 10 times. Intervals between injections of 24, 48, or 72 hours were used in the individual experiments. The mice were observed for a month, and the experiments were each repeated two to three times. The MIC of doxycycline for the 50 plague microbe strains studied ranged from 0.4 to 2.3 µg/ml (it was 0.8 µg/ml for most of the strains). The MIC of tetracycline ranged from 0.8 to 6.4 µg/ml (it equaled 3.2 µg/ml for most of the strains). Doxycycline proved more effective against plague microbes than tetracycline. This difference was especially apparent when the two antibiotics were administered in a dose of 50 mg/kg. At that dose, tetracycline was ineffective when used either for preventive or treatment purposes regardless of whether it was administered for 5, 7, or 10 days. Doxycycline, on the other hand, when administered under analogous conditions, protected 50-80 percent of the mice from death when administered for 5 or 7 days. When it was administered in a dose of 50 mg/kg for 10 days, it protected 100 percent of the mice from death. When the dose of the two antibiotics was increased to 100 mg/kg, tetracycline's prophylactic efficacy never exceeded 40 percent, and its therapeutic efficacy never exceeded 70 percent. Doxycycline, on the other hand, protected 100 percent of the animals from death. Further experiments established that the injectable (parenteral) form of doxycycline was superior to the oral form. When the two forms were administered for therapeutic purposes in a dose of 25 mg/kg, the injectable form resulted in a 90-100 percent survival rate versus only a 20-40 percent survival rate for the oral form. When the oral form of doxycycline was administered in a dose of 50 mg/kg, however, survival increased to 65-95 percent. The pathomorphological changes in the bodies of the white mice infected with plague microbe and then treated with doxycycline were limited to local changes at the infection site and in the regional lymph nodes, followed by the subsequent development of infiltration foci. Tables 3; references 8: 2 Russian, 6 Western.

Complex Evaluation of the Efficacy of Antibiotics With Experimental Typhus

947C0559E Moscow ANTIBIOTIKI I KHIMIOTERAPIYA in Russian Vol 38 No 8-9, Aug-Sep 93 (manuscript received 26 Feb 93) pp 51-55

[Article by T.M. Plekhanova, V.N. Lazarenko, and V.M. Ruchko, Virusology Center, Microbiology Scientific Research Center, Russian Federation Ministry of Defense, Sergiyev Posad; UDC 615.33:616.927]

[FBIS Abstract] A method was developed for integral (quantitative) evaluation of the anti-biotic sensitivity of *Rickettsia prowazekii* in guinea pigs. The process of developing the method included three stages as follows: identification of the most informative clinical indicators of the efficacy of chemical preparations in cases of experimentally induced typhus in guinea pigs and creation of an integral effect indicator on their basis; development of a method of indirect evaluation of the prophylactic effect of antibiotics on the multiplication and accumulation of *Rickettsia prowazekii* in the body based on the dependence of complement-binding antibody [CBAb] titer on the infective dose of *Rickettsia prowazekii*; and investigation of the possibility of complex evaluation of the efficacy of antibiotics in cases of experimentally induced typhus in guinea pigs. The method's effectiveness was demonstrated by way of the example of an experiment involving doxycycline. Data from experiments on 392 guinea pigs that had been infected with 10x dilutions of a strain of *Rickettsia prowazekii* Breynl [transliteration] in doses of 2.0 to 8.0 times the median infective dose [ID_{50}] were analyzed to identify informative indicators of antibiotic efficacy. Clear correlations between the magnitude of the infective dose and the following four indicators were observed: number of animals in which fever developed, duration of fever, incubation period, and average rise in body temperature. Through mathematical analysis of data from 21 experiments performed on 360 guinea pigs, the four informative indicators were systematized into an integral effect index that was in turn used as the basis of an indirect method of estimating the effect of antibiotics on the multiplication and breeding of *Rickettsia prowazekii*. The said indirect method was based on regression analysis of the log of the reciprocal of the CBAb titer as a function of the logarithm of the infective dose. The sensitivity of *Rickettsia prowazekii* to a given antibiotic was then determined on the basis of its integral effect index, coefficient of protection, and the dependence of the CBAb biter on the infective dose of rickettsia. An evaluation of doxycycline's efficacy against *Rickettsia prowazekii* Breynl (infective dose, 9.7 lg ID_{50}) in an experiment in which control animals were compared with animals receiving prophylactic and therapeutic doses of the antibiotic established that doxycycline does indeed have pronounced ($P > 99.9$ percent) prophylactic and therapeutic effects that are evident with respect to all four of the aforementioned informative indicators of antibiotic efficacy and the integral effect index. Figure 1, tables 3; references 15: 14 Russian, 1 Western.

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Antibacterial Activity and Clinical Efficacy of the New Antiseptic Miramistin

947C0559F Moscow ANTIBIOTIKI I KHIMIOTERAPIYA in Russian Vol 38 No 8-9, Aug-Sep 93 (manuscript received 16 Mar 92) pp 61-63

[Article by T.V. Vasilyev, A.S. Raskidaylo, A.A. Arutcheva, G.G. Okropiridze, A.A. Petrakov (deceased), Z.I. Urazgildeyev, and T.M. Kovalenko, Traumatology and Orthopedics Central Scientific Research Institute imeni N.N. Priorov, Moscow; UDC 615.281-615.33]

[FBIS Abstract] Miramistin (mirastamidopropyldimethylbenzylammonium chloride), which was developed at the Krymsk Medical Institute, is an odorless white crystalline powder surfactant that dissolves readily in water and other solvents. In its medicinal form (a 0.01 percent aqueous solution), miramistin possesses pronounced antimicrobial properties in relation to gram-positive and gram-negative bacteria, fungi, and several viruses and protozoa. It has low toxicity, has no lasting negative effects on the body when used in bactericidic concentrations, does not cause irritation or allergic reactions, and has no mutagenic or carcinogenic properties. A study examined its in vitro antibacterial activity and its clinical efficacy in patients suffering from purulent-inflammatory diseases of the locomotor system. Laboratory studies were performed on 236 clinical bacterial strains (226 isolated from patients with purulent-inflammatory diseases and 10 from sanitary-bacteriologic studies). Miramistin's activity against enterobacteria (30 stains), pseudomonads and other gram-negative bacilli (23 strains), staphylococci (120 strains), streptococci (12 strains), and obligate anaerobes (43 strains) was evaluated by three methods: diffusion from standard paper disks impregnated with a 0.01 solution of miramistin and applied onto a 5 percent blood agar surface infected with test culture, the "spot" method in which 1 drop (0.05 ml) of miramistin was pipetted onto a test culture surface of 5 percent blood agar, and the method of exposure in a 0.01 percent miramistin solution and (simultaneously) exposure in a 0.2 chlorohexidine solution. Miramistin's clinical efficacy was evaluated on 10 patients aged 15 to 55 years who had undergone surgery for chronic osteomyelitis. A 0.01 percent solution of miramistin was used to rinse the patients' drainage tubes and to coat the bandages and gauze used on their wounds. The studies performed by using the disk method did not yield any definitive results. The studies performed by the "spot" method, on the other hand, established that 65.3 percent of the bacterial strains tested are sensitive to a 0.1 percent solution of miramistin. This included 81.7 percent of the staphylococcal strains, all the streptococcal and unidentified gram-positive bacillus strains, and 60.5 percent of the anaerobe strains tested. Gram-negative microorganisms proved to be much less sensitive to miramistin: only 30 percent of the enterobacteria and 4.3 percent of the non-fermenting gram-negative bacilli were sensitive to it. In the studies performed by the exposure method, only a few strains of staphylococci and gram-positive bacilli survived (in amounts not exceeding 10^3 colony-forming units/ml). All of the gram-negative bacilli died within 6 hours of exposure to miramistin, and all of the streptococcal strains died within 1 hour. The said strains died much more rapidly in the 0.2 percent solution of chlorohexidine. The resistance of the study microorganism strains to miramistin did not depend on their sensitivity to antibiotics. Local treatment of the surgical patients' wounds with a 0.1 percent solution of miramistin for an average of 14 days resulted in lesser dissemination of pathological foci. Marked primary union of the surgical wound was observed in most patients. The results of using miramistin on the surgical patients were rated as good in seven patients, satisfactory in two patients, and unsatisfactory in one. None of the patients manifested any side effects as a result of miramistin. Miramistin was therefore recommended as an antiseptic for local treatment of infected wounds in trauma and orthopedic patients. Tables 3; references 3 (Russian).

Selected Indicators of the Functional Status of the Nervous System of Individuals Subjected to the Effect of the System of Adverse Factors Resulting From the Chernobyl Catastrophe

947C0560A Kiev FIZIOLOGICHESKIY ZHURNAL in Russian Vol 39 No 5-6, Sep-Dec 93 (manuscript received 5 Mar 93) pp 10-18

[Article by Ye.A. Vashchenko, Clinical Radiology Institute, Ukrainian Radiation Medicine Research Center, Ukraine Academy of Medical Sciences; UDC 612.014.481]

[FBIS Abstract] A clinico-neurophysiological study examined the functional status of various segments of the segmentary neuromotor apparatus of a group of individuals subjected to the system of adverse factors resulting from the accident at the Chernobyl Nuclear Power Plant. The study population included the following individuals: 45 males involved in clearing the accident in 1986 and 123 persons (79 males and 44) working in the 30-km zone around the Chernobyl plant. The members of the study population ranged in age from 20 to 59 years (average age, 41 years), and the doses of radiation incurred by them ranged from 5.0 to 25.0 cGy. The control group consisted of 30 healthy individuals from the same age group. The functional status of the afferent, central, and efferent components of their segmentary neuromotor apparatus was studied by electroneuromyography by using the Multibasis system produced by ESA OTE Biomedica (Italy). Their somatosensory sensitivity was studied by determining their tactile and pain thresholds on the backs of their hands and feet when subjected to electrical stimulation. The propagation rate of stimulation along the sensitive fibers of their median nerve was determined by the orthodrome method, and the condition of the postganglionic sympathetic fibers of the peripheral nerves innervating their hands and feet was studied by recording their evoked cutaneous sympathetic potential while they were resting on their backs after 5-10 minutes of rest at 22-24°C. The study population's spinal segmentary reflexes were determined by recording the H-reflex of their musculus

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soleus in response to electrical stimulation of the tibial nerve. Over 50 percent of the individuals studied were found to have some form of pathology of their autonomic nervous system. Clinically, this pathology appeared in the form of a syndrome of autonomic nervous system dystrophy with a preponderance of tonus of the parasympathetic nervous system (vagotonia). The said syndrome was determined to be permanent and, on rare occasions, accompanied by crises of the autonomic nervous system of primarily a vagoinsular nature. Patients complained of headache, dizziness, general (on rare occasions, acute) weakness, excessive fatigability, reduced ability to work, moodiness, and sleep disorders. Pains in the muscles, bones, and joints of the distal segments of the extremities were another common complaint. These subjective complaints correlated with the objective clinical picture of the patients' condition. Autonomic-vascular dysfunctions appeared in such forms as vasomotor lability, changes in dermographism, development of a "marble" skin color of the distal segments of the extremities, and general and local hyperhidrosis. Problems with the patients' surface sensitivity in the distal segments of their extremities were discovered. The electroneuromyography studies established that 30 percent of the individuals exposed to the radiation resulting from the Chernobyl accident had statistically significant increases in the values recorded for their evoked potentials and latent periods. These findings were taken as an indication of decreased tonus of the individuals' adrenergic sympathetic vasoconstrictors and cholinergic sudomotor fibers, which may be one of the pathogenic mechanisms of the said individuals' sensory and autonomic nervous system disorders. The conduction velocities of the sensory and motor nerves and the neuromuscular transmission of the individuals exposed to the consequences of the Chernobyl accident were found to be normal. Nor were any significant changes found in the parameters of their soleus H- and M-responses. It was stated that the decreased tonus of the sympathetic autonomic nervous system of the radiation-exposed patients may be due to monoaminergic neuromediation inhibition (decreased norepinephrine and dopamine excretion), which can induce psychoemotional disorders, depression, and sleep cycle disorders. No correlation was discovered between the dose of irradiation incurred and the indicators of autonomic nervous system functioning studied. Nor was it possible to determine the relative effect of the individual adverse factors resulting from the Chernobyl catastrophe. Tables 2; references 21: 15 Russian, 6 Western.

Molecular Aspects of the Effect of the Radioprotector Indralin

947C0554A Moscow IZVESTIYA AKADEMII NAUK. SERIYA BIOLOGICHESKAYA in Russian No 1, Jan-Feb 94 (manuscript received 12 Jul 93) pp 20-37

[Article by G.A. Chernov, T.G. Shlyakova, V.L. Sharygin, V.G. Sharf, I.N. Todorov, Yu.I. Mitrokhin, O.I. Yefremova, D.S. Khristianovich, T.V. Rozantseva, and M.K. Pulatova, Chemical Physics Institute imeni N.N. Semenov, Russian Academy of Sciences, Moscow; UDC 577.391:621.384:591.111]

[FBIS Abstract] Indralin is a radioprotector that was developed in Russia. Unlike existing radioprotectors, it exerts a pronounced radioprotective effect in large laboratory animals (dogs and monkeys). Indralin is effective not only against γ-irradiation but also against the effects of high-energy neurons on the body. A study examined the molecular aspects of indralin's effect on animals exposed to radiation. The study focused on the nature of the impairments of the biosynthesis and bioenergy systems in the tissues of irradiated animals, the nature of the radiation-induced changes in their blood and organs as revealed by electron paramagnetic resonance [EPR], and the effect of prophylactic administration of indralin in the said indicators. The studies were performed on 108 nonpedigree dogs (males and females weighing between 10 and 25 kg each) and nonpedigree white mice weighing 20-22 g each. The animals were observed from 15 minutes after they were irradiated to their death or, in the case of the survivors, 90 days after irradiation. The dogs were subjected to total-body γ-irradiation (^{60}Co) by an EGO-2 unit in doses ranging from 0.25 to 15 Gy at dose rates of 0.24-0.26 Gy/min and at a dose of 16 Gy by an LUE-8 with a dose rate of 50 Gy/min. Some of the dogs were administered intramuscular injections of indralin at a dose of 15 mg/kg 10 minutes before irradiation. Indralin had a pronounced radioprotective effect that was reflected both clinically and in the dogs' hematologic profiles. Next, the mice were subjected to γ-irradiation by a GUBE-1500 (^{60}Co) and IGUR (^{137}Cs) in doses ranging from 1 to 8 Gy at dose rates of 3.5 and 1.7 Gy/min, respectively. The mice were given intraperitoneal injections of indralin in tartaric acid at a dose of 15 mg/kg 10 minutes before irradiation. The radioisotope method was used to study the effects of indralin on DNA, RNA, and protein synthesis rates in the mice's livers and spleens. Indralin administered to intact mice was found to stimulate the biosynthesis of proteins and DNA in both the liver and spleen. Beginning on day 2 after the irradiation, protein synthesis in the mice's spleens gradually began increasing until it reached 150 percent of the control levels on days 10-15 after irradiation. Indralin had little effect on protein synthesis in the livers of the intact mice (in the said mice, protein synthesis peaked at 120 percent of the control level on day 10). Indralin stimulated DNA synthesis in the intact mice (it reached 1.5-1.7 times the level in the controls). The said levels of DNA synthesis were maintained for between 3 and 15 days. Administration of indralin also helped maintain levels of adenosine triphosphate and glycogen synthesis. Indralin attenuated the inhibiting effect of irradiation on the biosynthesis of macromolecules in the early postirradiation period and activated energy-intensive processes involved in the development of the body's compensatory-restorative responses to irradiation. Indralin also kept the said reactions from developing into hyperreactions inducing exhaustion of the viability of many important cellular and body systems after irradiation in lethal doses. Figures 11, tables 2; references 33: 12 Russian, 21 Western.

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Study of the Antimutagenicity of Bioginseng

947C0554C Moscow IZVESTIYA AKADEMII NAUK. SERIYA BIOLOGICHESKAYA in Russian No 1, Jan-Feb 94 (manuscript received 1 Jul 93) pp 48-55

[Article by R.A. Salikhova, N.V. Umnova, M.M. Fomina, and G.G. Poroshenko, Biophysics Institute, Russian Federation Ministry of Health, and Chemical Physics Institute imeni N.N. Semenov, Russian Academy of Sciences, Moscow; UDC 633.88:582.892:581.143.6]

[FBIS Abstract] Bioginseng is a biotechnology product obtained from a callus culture of ginseng root cells by lyophylization of the cells' biomass (bioginseng-1) and by means of alcohol extraction of the said biomass (bioginseng-2). A study examined the antimutagen properties of both types of bioginseng. The effect of bioginseng on the frequency of sister chromatid exchange and chromosome aberrations in a culture of Chinese hamster cells, chromosome aberrations in cells of the Ehrlich Institute of Chemical Physics [ICF] ascite strain developed in the abdominal cavity of mice, and micronuclei in mouse bone marrow cells was examined. The studies established that high doses of bioginseng (1,000 µg/ml) have a weak cytotoxic effect on Chinese hamster cells. By 36 hours of culturing, the Chinese hamster cells exposed to such doses of bioginseng only had time to complete one replication cycle. At lower doses (100 and 10 µg/ml), however, bioginseng had a stimulating effect on cell proliferation. This proliferating effect was especially pronounced in the case of bioginseng-1 (i.e., the bioginseng obtained by lyophilizing the biomass of ginseng cells). When bioginseng was added to culture media in doses of 10 and 100 µg/ml, the frequency of sister chromatid exchange decreased. In vitro studies of cultures of Chinese hamster cells confirmed that bioginseng has an antimutagenic effect with respect to both spontaneous and induced levels of aberrations. When added to a culture of Chinese hamster cells in a dose of 10 µg/ml, bioginseng-1 cut the frequency of chromosome aberrations in half. Bioginseng exerted an antimutagenic effect with respect to both nitrosomethylurea [NMU] and cyclophosphamide. The protective (antimutagenic) effect of bioginseng was most pronounced when it was introduced 2 hours before the mutagen. Specifically, when NMU was injected intraperitoneally (in a dose of 100 mg/kg) into mice into whom cells of the Ehrlich-ICF ascite strain had been introduced, chromosome aberrations appeared in 96 percent of the tumor cells. In those cases where the mice had received bioginseng 2 hours prior to being injected with NMU, the number of cells with chromosome aberrations decreased to 67 percent. The antimutagen properties of bioginseng were also observed in the experiments performed with mouse bone marrow cells and with the biomutagen cyclophosphamide. As in the previous experiments, bioginseng-1 proved a more effective antimutagen than bioginseng-2. In a dose of 100 mg/kg, bioginseng reduced the number of cells with micronuclei in the mouse bone marrow even when compared with the control level in intact mice. Bioginseng was concluded to enhance DNA repair in cells exposed to mutagens. Tables 4; references 24: 19 Russian, 5 Western.

Study of Monooxygenase Oxidation Enzymes in Human Lymphocytes and Livers Exposed to the Effect of Chlorophenoxy Herbicides

947C0554D Moscow IZVESTIYA AKADEMII NAUK. SERIYA BIOLOGICHESKAYA in Russian No 1, Jan-Feb 94 (manuscript received 9 Apr 91) pp 56-63

[Article by V.A. Ostashevskiy, K.Ye. Gerasimov, I.B. Tsyrlov, and V.S. Rumak, Clinical and Experimental Medicine Institute, Siberian Department, Academy of Medical Sciences, Russian Academy of Sciences, and Russian-Vietnamese Tropical Scientific Research and Testing Center, Russian Academy of Science, Ho Chi Minh City, Vietnam; UDC 616.36-008.831:615.917:612.112.94]

[FBIS Abstract] A study examined the activity of benzopyrene hydroxylase (cytochrome P-450IA1) in a mitogen-stimulated culture of lymphocytes obtained from the peripheral blood of individuals living in an area of South Vietnam that had been treated with chlorophenoxy herbicides during the Vietnam War. The experimental group contained 62 inhabitants of a South Vietnamese village who had been subjected to Agent Orange during the Vietnam War. The control group contained 32 persons from the same South Vietnamese province (but located 75 miles away from the village of residence of the experiment group) who had not been exposed to Agent Orange. Both groups consisted exclusively of males between the ages of 30 and 50 years. The activity of benzopyrene hydroxylase (cytochrome P-450IA1) was studied in mitogen-stimulated cultures of peripheral blood lymphocytes taken from the members of both groups. Basal and induced benzopyrene hydroxylase activity levels and inducibility ratios were determined for each member of the two groups. Next, antipyrene was administered to the members of the experimental group in a dose of 18 mg/kg. The men's urine was sampled 2 days later, and 10 ml of the men's urine was frozen for storage. The amount of antipyrene and its metabolites present in the urine samples was determined by high-pressure liquid chromatography. The antipyrene and metabolites were extracted from 400 µl of urine by one of two systems. The data collected were subjected to a computer analysis of the monooxygenase system in the lymphocytes of the men from both groups in order to identify correlations between the level of antipyrene metabolites in the men's urine and levels of cytochrome P-450IA1 in their blood lymphocytes. No fundamental differences between the two groups' levels of basal and induced activity of benzopyrene hydroxylase were found. No statistically significant differences were discovered in the inducibility ratios calculated for the two groups of men; however, the values calculated for the men residing in the area treated with Agent Orange did tend to be higher than those of the men from the area not treated with the herbicide. A study of intragroup correlations between benzopyrene hydroxylase activity in the lymphocytes and antipyrene activity in the livers of the men from both villages established several interesting facts. First, there was a correlation between basal benzopyrene hydroxylase activity level and formation of 4-hydroxyantipyrene. Also

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deemed noteworthy was a negative correlation between low level of benzopyrene hydroxylase activity (0.08 nmol/million cells/min) and the inducibility ratio among the inhabitants of the village treated with Agent Orange. In the said men, the basal benzopyrene hydroxylase activity level correlated with a decrease in the relative level of excretion of nonmetabolized antipyrene and with the total increase in all products of monooxygenase reactions in the liver. When compared with the values plotted for the experimental group on the histograms of output of the metabolites 4-hydroxyantipyrene and norantipyrene from the livers, the values obtained for the control group were "shifted to the left." Furthermore, in the experiment group, there was a pronounced correlation between the metabolite 4-hydroxyantipyrene and the products specific for other isoforms of cytochrome P-450 (namely, norantipyrene and 3-hydroxymethylantipyrene). These findings were interpreted as evidence that 2,3,7,8-tetrachlorodibenzo-p-dioxin induces other forms of cytochrome P-450 in the liver in addition to p-450IA1. Figures 3, tables 2; references 16: 3 Russian, 13 Western.

Dose-Dependent Changes in Electrical Activity of Brain Formations Induced by GABA Agonists and Antagonists on Intraventricular Administration

947C0539A Moscow EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA in Russian Vol 57 No 4, Jul-Aug 94 (manuscript received 26 May 93) pp 6-11

[Article by A.V. Yarkov, G.I. Kovalev and A.A. Galchenko, Laboratory of Functional Neurochemistry, Institute of Theoretical and Experimental Biophysics, Russian Academy of Sciences, Pushchino, Moscow Oblast; Laboratory of Neurochemical Pharmacology, Institute of Pharmacology, Russian Academy of medical Sciences, Moscow; UDC615.31:547.466.3].015.4:612.822.3].076.9]

[FBIS Abstract] An analysis was conducted on the dose-dependent effects of intraventricularly administered GABA and its agonists (muscimol, baclofen) and an antagonist (bicucullin) on the electrical activity of the occipital cortex, putamen, dorsal hippocampus and medial hypothalamus in 300-350 g male Wistar rats. The formations selected differ in the type and tissue concentration of GABA receptors. The overall impression was that bicucullin has little effect on the spectral patterns, regardless of concentration. Statistical analysis of the effects of GABA and muscimol showed maximum frequency reversion at 10E-9 M in a dose-dependent fashion. In addition, α-band 10E-6 M GABA and 10E-9 M muscimol attenuated α-activity, while 10E-8 M muscimol had an enhancing effect. In general, these observations demonstrated an interdependence of the different types of GABA receptors. Figures 2; tables 4; references 18: 12 Russian, 6 Western.

Modulation of EEG Effects of GABA by Perfluorocarbon Emulsions in Rats

947C0539A Moscow EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA in Russian Vol 57 No 4, Jul-Aug 94 (manuscript received 14 Apr 93) pp 11-13

[Article by V.V. Vorobeyev, T.F. Gorelkova, N.I. Kukushkin and L.S. Kosarskiy, Laboratory of Medical Biophysics, Institute of Cell Biophysics, Russian Academy of Sciences, Pushchino, Moscow Oblast; UDC616.831-005.4-085:31:546.26]-036.8-07]

[FBIS Abstract] Trials on 300-350 g male Wistar rats were designed to assess modulation of EEG effects evoked by intraventricular administration of 10E-6 M GABA by the following agents: intraventricular or intravenous pretreatment with perfluorocarbon emulsion and intraventricular proxanol-268 (sufactant used in the emulsion). Assessment of changes in the 1-30 Hz band of EEG showed that perfluorocarbon and proxanol-268—given intraventricularly 1.4 h before GABA—inhibited the effects of GABA. Intravenous administration of the perfluorocarbon emulsion was ineffective. These observations demonstrated that under normal conditions the emulsion does not permeate the blood-brain barrier and that the proxanolol-268 component may well account for the effectd observed. Whether the emulsion permeates the blood-brain barrier in the ischemic brain remains an open question. Figures 2; references 13: 6 Russian, 7 Western.

Experimental Studies on 'Suicrepan' (Porcine Secretin Preparation)

947C0539C Moscow EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA in Russian Vol 57 No 4, Jul-Aug 94 (manuscript received 13 May 93) pp 36-39

[Article by I.I. Sheleketina, S.M. Drogovoz, L.P. Averyanova and I.A. Zupanets, Biochemistry Laboratory, Dnepropetrovsk Scientific Research Institute of Gastroenterology; Chair of Pharmacology, Kharkov Pharmaceutical Institute, Kharkov; UDC615.357:577.175.736].038]

[FBIS Abstract] Pharmacodynamic and therapeutic evaluations of suicrepan were carried out on 66 outbred dogs, 10 chinchilla rabbits, 579 albino rats and 100 albino mice. Suicrepan was shown to increase pancreatic juice secretion 4- to 6-fold in a dose-dependent manner, and induce a 3- to 5-fold increase in the bicarbonate level. In addition, suicrepan was found effective in reducing mortality in experimental pancreatitis and to possess analgesic properties. The LD50 values for rats and mice on intravenous administration were 1128.6 and 821.7 mg/kg, respectively, thus indicating a high margin of therapeutic safety. Tables 1; references 19: 12 Russian, 7 Western.

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Physicochemical Structure-Anticoagulant Activity Relationships of Polysulfonated Chitosan Derivatives

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[Article by N.N. Drozd, A.I. Sher, V.A. Makarov, L.S. Galbrakh, G.A. Vikhoreva and I.N. Gorbacheva, Laboratory of Pathology and Pharmacology of Hemostasis, Hematologic Scientific Center, Russian Academy of Medical Sciences; Chair of Chemical Fiber Technology, Moscow State Textile Academy; UDC615.273.53:547.458.81].011.07]

[FBIS Abstract] The search for heparin congeners stimulated studies on polysulfonate chitosans (PSC) for anticoagulant properties in outbred rabbits. The findings demonstrated that PSCs with anticoagulant properties had the following characteristics: degrees of polymerization ranging from 71 to 547 (1.0-4.0 m^3/kg viscosity), and $NaSO_3$ substitutions of 0.62-1.86 (8.8-16.9% sulfur). The best PSCs (30-52 IU/mg) were characterized by degrees of polymerization and substitution of 180-240 and 1.5, respectively. The half-life values for PSC elimination ranged from 37 to 50 min, and the elimination constants from 1.38 x 10E-2 to 1.88 x 10E-2 min^{-1}. Tables 4; references 20: 5 Russian, 15 Western.

Sparing Effects of 'Essentiale'-Nikethamide Combination on Hepatic Monooxygenase and Glucuronyl-Glutathione Transferase in CCl_4-Treated Rats

947C0539E Moscow EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA in Russian Vol 57 No 4, Jul-Aug 94 (manuscript received 06 Apr 93) pp 62-63

[Article by M.I. Bushma, L.F. Legonkova, L.B. Zavodnik, I.V. Zverinskiy and P.I. Lukiyenko, Laboratory of Biochemical Pharmacology, Institute of Biochemistry, Belarussian Academy of Sciences, Grodno; UDC615.272.4.015.4.076.9]

[FBIS Abstract] Pharmacodynamic studies were performed on outbred male rats, 150-200 g, to assess the sparing effects of nikethamide and its combination with 'essentiale' (Natterman, Germany) on hepatic monooxygenase and glucuronyl-glutathione transferase activities in CCl_4-treated animals (0.5 ml/100g of 50% CCl_4; intragastric). Essentiale was administered 24 h after CCl_4 (0.2 ml/100 g/day for 3 days) alone or in combination with nikethamide (25 mg/ml of essentiale). Four days after CCl_4 administration there was marked reduction in hepatic cytochromes P-450 and b_5, activities of the corresponding reductases, rate of NADP.H oxidation, N-demethylation of ethylmorphine and glucuroconjungation of p-nitrophenol. While essentiale alone attenuated these changes, best reversal of the adverse effect was seen with the combined drug regimen. The efficacy was attributed to stabilization of microsomal membranes and induced proliferation of the membranes of the smooth endoplasmic reticulum. Figures 1; tables 1; references 19: 11 Russian, 8 Western.

5-HT_3 Receptor Blockers: Novel Antiemetic Agents

947C0539F Moscow EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA in Russian Vol 57 No 4, Jul-Aug 94 (manuscript received 20 Aug 92) pp 72-75

[Article by V.I. Legeza, Scientific Research Institute of Military Medicine, St. Petersburg; UDC615.243.5.07]

[FBIS Abstract] Predominantly Western scientific literature is surveyed to demonstrate the involvement of serotonergic mechanisms in nausea and emesis. Particular attention is accorded to the fact that serotonin antagonists acting on 5-HT_3 type of receptors might constitute promising antiemetics. Analysis of the available experimental data indicates that a possible mechanism of the antiemetic effect is based on the involvement of the 5-HT_3 receptors in mediating release of serotonin from enterochromaffin cells. References 48: 6 Russian, 42 Western.

Pharmalogical Properties of Karazedin

947C0564A Moscow EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA in Russian Vol 57 No 2, Mar-Apr 94 (manuscript received 23 Apr 93) pp 4-6

[Article by N.K. Barkov, N.M. Serpilina, L.A. Surkova, L.M. Sharkova, D.Yu. Rusakov, and I.V. Tyurina, Chemistry of Heterocyclic Compounds Laboratory (head, V.L. Savelyev, candidate of chemical sciences), Pharmacology Institute, Russian Academy of Medical Sciences, and Pharmacotherapy of Drug Addiction Experimental Laboratory (head, S.K. Sudakov, doctor of medical sciences, State Scientific Center for Narcology, Russian Federation Ministry of Health, Moscow; UDC 615.214.03:616.89-008.441.13].07]

[FBIS Abstract] The carbidine analogue 1,2,3,4,5,5a,6,10b-octahydroazepino(4,5-b)indole,which is readily soluble in water, melts at 235-237°C, and has been given the name karazedin [transliteration], was tested to evaluate its psychotropic properties. The effects and toxicity of karazedin were compared with those of carbidine and Aminazine (chlorpromazine). The effects of karazedin and karazedin in combination with phenamine (amphetamine) and reserpine were also compared. The experiments, which were conducted on nonpedigree white mice and rats and monkeys (rhesus and macaca), focused on the drugs' effects on motor activity, aggressive behavior, conditioned and unconditioned reflexes, positively motivated conditioned reflexes, experimentally induced neuroses, and muscle attenuation, as well as on their overall effect and toxicity. Karazedin was confirmed to possess properties characteristic of neuroleptics and tranquilizers. From the standpoint of its effect on motor activity, karazedin was significantly superior to carbidine but inferior to Aminazine. Phenamine did not excite motor activity in

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subjects that had previously been injected with karazedin. From the standpoint of its effect on aggressive behavior in monkeys, karazedin was more active than carbidine: It proved longer-lasting and had a sedating effect. Karazedin also had a stronger effect on defensive conditioned reflexes than on reactions based on positive reinforcement. It also suppressed unconditioned defensive avoidance reactions. Phenamine proved to be an antagonist to karazedin in all of the tests conducted. Karazedin had no significant effect on arterial pressure when administered in intravenously injected doses of 3 and 5 mg/kg. When injected subcutaneously in a dose of 10 mg/kg, it induced temperature decreases in mice of 2.4°C. Karazedin had a muscle-attenuating effect only when injected subcutaneously in high doses (median effective dose [ED_{50}] = 17.5 (13.0-23.4) mg/kg; however, its muscle-attenuating effect is 15.3 times weaker than that of Aminazine. Studies of karazedin's toxicity on white mice established that its average lethal concentration [LD_{50}] is 72 (47-107) mg/kg when injected intravenously and 110 (90-132) when injected subcutaneously. Karazedin significantly reduces phenamine's toxicity when the two drugs are injected together. Specifically, it reduces phenamine's toxicity by a factor of 3.1 (2.4-4). Figure 1, table 1; references 11: 8 Russian, 3 Western.

Selectivity of the Effect of Muscarinic Agonists in Vivo

947C0564B Moscow EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA in Russian Vol 57 No 2, Mar-Apr 94 (manuscript received 4 Nov 92) pp 6-8

[Article by A.B. Kosmachev, I.M. Kosmacheva, M.V. Yankhotova, and V.I. Kuleshov, Toxicology Institute, Russian Federation Ministry of Health, Saint Petersburg; UDC 615.31:547.447.5].015.21.07]

[FBIS Abstract] The selectivity of the effect of selected muscarinic agonists was studied in a series of in vivo experiments on male rats weighing 160 to 240 g each. Tremor was induced in the animals by intravenous injection of the cholinomimetics pilocarpine, oksotremorin [transliteration], aceclidine, physostigmine, arecoline, and galantamine. The doses of the agonists were selected experimentally such that the previously injected dose of atropine (median effective dose [ED_{50}]) amounted to about 1 mg/kg. The doses of cholinomimetics established in the experiments with atropine were used to determine the ED_{50} of amedine. The ED_{50} of the cholinolytics was determined 30 minutes before the experiments by subcutaneous injection of the cholinolytics into four groups of animals in successively higher doses with an interval of 0.1 on a log scale. Each dose of drug was injected in groups of two animals each. A comparison of the nature of the reaction of the muscarinic antagonists with specific biological targets from various murine tissues established that the dissociation constant [Kd] of choline receptor complexes from a homogenate of murine heart muscle and atropine (4.79 +/- 0.22) are significantly different from the Kd of choline receptors from a homogenate of murine heart muscle and amedine (33.06 +/- 6.65). When cerebral cortex tissue was used as an M-choline receptor source, the values of Kd calculated for homogenates containing atropine and amedine were not significantly different from one another (2.52 +/- 0.56 versus 2.71 +/- 0.89). Thus, atropine's and amedine's affinity to choline receptor of the M2 subtype are very different from one another. These findings were used as the basis for developing a methodology for in vivo study of selectivity in the effect of muscarinic agonists. In essence, the new approach entailed comparing equally effective doses of atropine and amedine under conditions of their antagonism with the study cholinomimetic. Further tests established that in cases of tremor induced by pilocarpine, oksotremorin, and aceclidine, the ED_{50} of atropine and amedine are not significantly different from one another, whereas in cases where tremor is induced by physostigmine, arecoline, and galantamine, amedine is less active than atropine. A comparison of these results with data regarding the selectivity of the specified M-cholinolytics established that in in vivo experiments, muscarinic agonists are capable of manifesting selectivity with respect to different M-choline receptor subtypes. It was emphasized that information regarding the selectivity of M-cholinomimetics in vivo is not also consistent with information regarding their selectivity in vitro. Tables 2; references 12: 3 Russian, 9 Western.

Effect of Serotonin on Pain Sensitivity and Nociceptive Arterial Pressure Responses

947C0564C Moscow EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA in Russian Vol 57 No 2, Mar-Apr 94 (manuscript received 23 Apr 92) pp 11-13

[Article by A.A. Arinova, Pharmacology Institute (head, Yu.D. Ignatov, professor and corresponding member of the Russian Academy of Medical Sciences), Saint Petersburg Medical Institute imeni I.P. Pavlova, Saint Petersburg; UDC 615.357:577.175.823].015.4:616.8-009.7].07]

[FBIS Abstract] The effect of serotonin on pain sensitivity and nociceptive arterial pressure responses was studied in experiments performed on 69 nonpedigree male rats weighing 170 to 220 g each. The tail-flick test and electrical stimulation of the skin on their backs at the L2-4 level through previously implanted electrodes were used to measure pain sensitivity. Arterial pressure during the pain stimulation process was recorded by means of a siliconized catheter and Istok-002 automated measuring unit. The serotonin was injected intravenously through a catheter implanted in each animal's femoral vein. The volume of solution injected never exceeded 10-20 µl. The serotonin (serotonin creatinine-sulfate, Reanal, Hungary) was injected intravenously in doses of 0.1 and 1 mg/kg and intrathecally in doses of 1, 3, 5, 10, 50, and 100 µg. Naloxone was injected intravenously in a dose of 0.1 mg/kg. Twenty minutes after the intravenous injection of serotonin at a dose of 0.1 mg/kg, the latent period of the jerking back of the serotonin-injected rats' tails was increased 20-30 percent versus that of the control animals' tails. This effect persisted for 60 minutes. When serotonin

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was injected in a dose of 1 mg/kg, the said lengthening of the latent period occurred much more rapidly (by 5 minutes after the injections). The said doses did not, however, alter the animals' vocalization threshold in response to electrical stimulation of the skin on their backs. When injected intrathecally in doses of 1, 3, and 5 μg, serotonin lengthened the latent period of the jerking back of the rats' tails in a dose-dependent manner. When serotonin was injected in doses of 10, 50, 100 μg, it lengthened the latent period up to 300 percent. At the same time, serotonin in the said doses did not alter the animals' vocalization threshold, which only increased at a serotonin dose of 200 μg. Doses in excess of 100 μg could not be used, however, because they induced paresis of the animals' rear extremities. Against a background of preliminary injection of naloxone (0.1 mg/kg intravenously), the latent period of the jerking back of the rats' tails increased within the first 5 minutes after the intrathecal injection of serotonin. Microinjection of serotonin without preliminary injection of naloxone induced a maximum increase in the latent period 15-30 minutes after the injection. When the rats had first been injected with naloxone, however, the lengthening of the latent period was noted only after 45-50 minutes. In both cases, the latent period was the same after 60 minutes and did not exceed 200 percent of the control level. Throughout the entire range of doses studied with both the intravenous and intrathecal routes of injection, serotonin did not have any statistically significant effect on the level of arterial pressure. Only in the first 1-2 minutes after intrathecal microinjection of serotonin did a slight and brief elevation in arterial pressure occur. Intrathecal injection of serotonin against a background of naloxone did not alter the background arterial pressure either. Serotonin did, however, increase the amplitude of the nociceptive arterial pressure pressor response with both the intravenous and intrathecal routes of injection. The increase in arterial pressure in response to a pain stimulus averaged 18.5 and 25.3 mm Hg upon intravenous and intrathecal administration of serotonin, respectively. Thus, serotonin exerted an analgesic effect in the tail-flick test but did not alter pain sensitivity in the electrical skin stimulation test. The fact that the rats proved more responsive in the tail flick test than in the electrical stimulation test was attributed to serotonin's effect on the serotoninergic neuronal structures of the spinal cord. Tables 2; references 13: 1 Russian, 12 Western.

Effect of Cytochrome C Preparations on Brain Blood Circulation in Cases of Cerebral Ischemia

947C0564D Moscow EKSPERIMENTALNAYA I KLINICHESKAYA FARMAKOLOGIYA in Russian Vol 57 No 2, Mar-Apr 94 (manuscript received 5 Apr 93) pp 22-24

[Article by V.V. Gatsura, M.D. Gayevyy, Ye.R. Davidov, V.Ye. Pogorelyy, and V.O. Pyzhyy, Biologically Active Substances All-Russian Scientific Center, Moscow, Protein Synthesis Scientific Research Institute, Moscow, and Pyatigorsk Pharmaceutical Institute, Pyatigorsk; UDC 615.152.122.015.4:616.831-005.4].07]

[FBIS Abstract] The effects of cytochrome C of biotechnological origin, heme-tetradecapeptide [HTDP], and cytochrome C of animal origin on the cerebral blood circulation of intact rats with cerebral ischemia were studied in a series of experiments conducted on nonpedigree white rats weighing 180 to 220 g each that had been anesthetized with nembutal and placed on artificial ventilation. Their rate of cerebral blood circulation was measured by the method of hydrogen clearance in the confluence of their sinuses. Cerebral ischemia was induced in the rats by pinching both of their carotic arteries. A microperfuser with a rate of 0.4 ml/min was used to administer all substances in doses of 5 and 20 mg/kg. HTDP was injected in heme-isomolar doses of 0.8 and 3.3 mg/kg. All substances administered for prophylactic purposes were injected 30-40 minutes before ischemia was induced, and all substances administered for therapeutic purposes were injected 15 minutes after ischemia had been induced. Eight experiments were included in each series. The effect of cytochrome C on tonus of the cerebral vessels was studied in experiments on cats of both sexes that weighed 2.5 to 3.5 kg each. Blood glucose levels were determined 15, 30, 60, and 90 minutes after ischemia had been induced. The experiments established that cytochrome C of animal origin and cytochrome C of biotechnological origin did not induce significant alterations in cerebral blood circulation. The only exception to this pattern was cytochrome C of biotechnological origin, which induced a significant increase in blood circulation when injected in a dose of 20 mg/kg. All changes in blood circulation observed during the experiments were dose dependent. As the doses of all three substances tested were increased, the decrease in blood circulation versus that in the controls became less pronounced. Under conditions of experimentally induced ischemia, both cytochrome C of animal origin and cytochrome C of biotechnological origin increased cerebral blood circulation when administered both prophylactically and therapeutically. The observed effect lasted for 30-40 minutes after therapeutic injection and for 20-40 minutes after prophylactic injection. Increasing the dose of the two preparations in the postischemia period did not result in an increase in cerebral blood circulation. In the absence of experimentally induced pathology, injection of HTDP in doses of 0.8 and 3.3 mg/kg did not induce any alterations in cerebral blood circulation either. The only statistically significant increase in cerebral blood circulation over control levels noted in the case of HTDP was observed 5 minutes after it was injected in a dose of 0.8 mg/kg. Prophylactic injection of HTDP in both doses increased cerebral blood circulation over the control levels. Its effect was less pronounced and longer lasting at the lower dose. The injection of HTDP in a dose of 0.6 mg/kg against the background of cerebral ischemia induced a statistically significant increase in cerebral blood circulation when compared with the control levels throughout the entire 60-minute observation period. Analogous injection of HTDP in a dose of 3.3 mg/kg only increased cerebral blood circulation for the first 15-20 minutes after injection. Injection of HTDP did not result in any statistically significant alterations in

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systemic arterial pressure when compared with control levels. Like both types of cytochrome C, HTDP inhibited negative shifts in cerebral blood circulation; however, its effect was less intense and less persistent than that of the two types of cytochrome C. Tables 2; references 5: 4 Russian, 1 Western.

Effect of Dalargin on the Course of Experimentally Induced Cardiac Arrythmias

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[Article by T.I. Grekova, K.M. Reznikov, O.V. Vinokurova, A.A. Kireyeva, T.I. Taratinova, V.A. Nikolayevskiy, and N.A. Shchetinkina, Faculty Treatment Department (head, Prof. V.M. Provotorov) and Pharmacology Department (head, Prof. K.M. Reznikov), Voronezh Medical Institute, Voronezh; UDC 615.31:[547.95:547.95:547.943].03:616.12.-008.318.-092-085]

[FBIS Abstract] The anti-arrythmic and anti-fibrillator properties of dalargin were examined in a series of experiments performed on 81 white Wistar rats weighing 180 to 250 g each and 58 nonpedigree dogs weighing 7 to 17 kg each. The animals were anesthetized with pentobarbital (40 µg/kg). In addition, the dogs received 1 percent promedol (1 ml/kg) with 0.1 percent atropine (0.05 ml/kg). To reproduce arrythmia in the rats, they were injected with aconitine in a dose of 40 µg/kg or calcium chloride in a dose of 300 mg/kg. In one series of experiments, 5 minutes before intravenous injection of the arrythmics, the animals were administered a solution of dalargin (200 µg/kg) or lidocaine (0.75 mg/kg). Ventricular hyponatremic fibrillation was simulated in an isolated rat heart. In the said experiment, 5 minutes before the concentration of sodium chloride was reduced, the heart was perfused with a solution of dalargin in a concentration of 1.07×10^{-6} mol/l or morphine in a concentration of 6.23×10^{-6}. The same concentrations were maintained in the hyponatremic solution. After fibrillation began, the initial solution was added to study the time required for restoration of cardiac rhythm. The dogs' electrocardiograms, systolic and diastolic arterial pressure, heart rate, and circulation rate were recorded. The dogs were subjected to ligation of their left intraventricular coronary arteries. Dalargin in a dose of 100 µg/kg (diluted in a physiologic solution) was slowly intravenously administered to 14 dogs before ligation and to 6 dogs 3-5 minutes after ligation. A solvent or 0.25 percent trimecaine hydrochloride solution in a dose of 10 µg/kg was analogously administered to the controls. Electrical defibrillation (with a discharge of 4 kV) was performed on the open hearts of 20 dogs after the development of fibrillation in their hearts. If a dog survived, reperfusion fibrillation was simulated in its heart by removing the ligature from its coronary artery 20 minutes after the ligation. In the aconitine and calcium chloride models, dalargin in a dose of 200 µg/kg delayed both the development of arrythmias and death and improved survival in rats. In a concentration of 1.07×10^{-6} mol/l, it reduced the number of cases of development of fibrillation and increased the time required for the development of fibrillation in an isolated heart. When injected into the coronary arteries of dogs both before and after ligation, dalargin in a dose of 100 µg/kg provided an antifibrillatory effect as good as that of trimecaine hydrochloride. The said dose of dalargin prevented reperfusion arrythmia in 30 percent of cases and facilitated the elimination of fibrillation by electrical defibrillation during both ligation and reperfusion. In intact dogs and in cases of myocardial infarction, dalargin in a dose of 100 µg/kg manifested a moderate chronotropic effect that was eliminated by atropine. Dalargin in the said dose decreased arterial pressure only slightly and did not significantly alter the principal indicators of hemodynamics. Tables 2; references 11: 6 Russian, 5 Western.

Antithrombotic Effect of Protein Activator C From *Agkistrodon blomhoffi ussuriensis* Venom During Thrombus Formation in Extracorporeal Shunt in Rats

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[Article by A.Ye. Kogan, G.V. Bashkov, I.D. Bobruskin, Ye.P. Romanova, V.A. Makarov, and S.M. Strukova, Hematology Scientific Center, Russian Academy of Medical Sciences, Moscow, and Biology Department, Moscow State University, Moscow; UDC 615.273.55:615.919:598.12].015.4.076.9]

[FBIS Abstract] The antithrombotic effect of protein C activator from the venom of the poisonous snake *Agkistrodon blomhoffi ussuriensis* on thrombosis was studied in a model of thrombocyte-dependent thrombus formation in an extracorporeal arteriovenous shunt in rats. The protein C was isolated from bovine blood plasma as described elsewhere. High-performance liquid chromatography was used to isolate the protein C activator from the *Agkistrodon blomhoffi ussuriensis* venom at room temperature and a pH of 7.2. The technique used to model thrombosis in an arteriovenous shunt was a modification of that described by Umetsu. The antithrombotic effects of protein C activator were studied in 40 male Wistar rats weighing 200 to 250 g each that had been anesthetized with intraperitoneal urethane in a dose of 1.5 g/kg. After a shunt had been established in the rat's jugular vein, an 0.5-ml sample of its blood was taken and mixed with 0.11 M sodium citrate in a 9:1 ratio, after which 0.5 ml of activator in a physiologic solution was added in a dose of 35 or 70 U/kg (the initial concentration in the blood plasma was 1 or 2 U/ml). A second blood sample was taken 1 minute after the clamps had been removed and blood began to flow in the shunt. A third blood sample was taken after a thrombus had formed. The activated partial thromboplastin time was determined in the blood samples by using the partial thromboplastin (neothrombin) time, and factor

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V and VIII activity was determined by the one-step method using plasma deficient in factor V or VIII. Protein C activity, activity of tissue plasminogen activator, and fibrinolytic activity of the diluted rat blood were also determined. The effect of activator on thrombocyte aggregation was studied in vitro in thrombocyte-enriched plasma obtained by centrifuging rat blood at 1,000 rpm for 15 minutes. The thrombocyte formation time was significantly greater in rats injected with protein C activator than in control rats (5.1 +/- 3.4 and 7.9 +/- 1.1 minutes in rats receiving the protein C activator in doses of 35 [n = 6] and 70 [n = 5] U/kg versus 3.5 +/- 1.4 minutes in the controls [n = 11]. Administration of protein C activator in doses of 35 and 70 U/kg also resulted in the following respective changes in blood coagulation indicators: a decrease in the level of protein C to 66 +/- 17 and 53 +/- 8 percent; a decrease in factor V activity to 53 +/- 11 and 39 +/- 13 percent; and an increase in the activated partial thromboplastin time from 35 +/- 5 to 77 +/- 53 and 92 +/- 35 seconds. The administration of protein C activator did not, however, alter factor VIII, tissue plasminogen activity, or fibrinolytic activity. No changes in adenosine diphosphate and adrenalin-induced thrombocyte aggregation as result of protein C activator were discovered under in vitro conditions; however, adhesion of thrombocytes to the glass after dilution of the activator to the final concentration (2 U/ml) decreased from 19.4 +/- 5.4 to 10.9 +/- 5.0 percent. Protein C activator obtained from the venom of *Agkistrodon blomhoffi ussuriensis* was thus confirmed to have an antithrombotic effect in a model of thrombocyte-dependent thrombus formation in an arteriovenous shunt. The said anti-thrombotic effect was linked with inactivation of factor V mediated by activation of protein C and with a decrease in thrombocyte adhesion. Figures 2; references 18: 2 Russian, 16 Western.

Use of a Complex Cobalt Compound as a Cyanide Antidote

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[Article by B.A. Bovykin, Inorganic Chemistry Department (head, Prof. B.A. Bovykin), Dnepropetrovsk Chemical Technology Institute, Ukraine; UDC 615.916:546.733].015.25].03]

[FBIS Abstract] A study examined the efficacy of a complex compound of cobalt (III), i.e., $[Co(DH)_2(H_2O)_2]Cl$, as a cyanide antidote. $[Co(DH)_2(H_2O)_2]Cl$ was produced by reacting an aqueous solution of $[Co(DH)_2(H_2O)OH]$ with hydrochloric acid. The starting complex was synthesized from $CoCl_2 6H_2O$, dimethylglyoxime, and Perhydrol. The resultant $[Co(DH)_2(H_2O)_2]Cl$ was a brown crystalline material that dissolves readily in water and organic solvents. The toxicity of $[Co(DH)_2(H_2O)_2]Cl$ was evaluated by intraperitoneal injection of the compound into 90 nonpedigree mice, and its anticyanide activity was studied in 32 cats of both sexes that weighed 2-4 kg each. The toxicology studies established that $[Co(DH)_2(H_2O)_2]Cl$ has a fairly low toxicity (median lethal dose [LD_{50}], 908 mg/kg). The studies conducted on the cats established that intravenous injections of $[Co(DH)_2(H_2O)_2]Cl$ in doses of 40 and 80 mg/kg into cats that had been poisoned with potassium cyanide in a dose of 1 mg/kg react directly with the cyanide and reverses the cyanide's sharp inhibition of the brain's bioelectric activity. Specifically, the cats were divided into four groups. The eight cats in group 1 (the controls) were given intravenous injections of cyanide at a dose of 1 mg/kg. The electroencephalograms [EEGs] recorded for the six surviving cats confirmed the dramatic inhibitory effect of potassium cyanide on the cats' brain activity. Specifically, the cats' brain waves flattened into a straight line and remained that way for an average of 325 seconds. Their normal brain activity (as evidenced by a resumption of normal brain wave patterns on their EEGs) was restored after 30 minutes on average. The cats in group 2 received $[Co(DH)_2(H_2O)_2]Cl$ in a dose of 20 mg/kg together with a 1-mg/kg dose of potassium cyanide. In the said cats, complete bioelectric suppression (as evidenced by a flat line on their EEGs) lasted an average of 100 seconds, and their normal EEG patterns returned after an average of 20 minutes. The cats in groups 3 and 4 received $[Co(DH)_2(H_2O)_2]Cl$ in doses of 40 and 80 mg/kg together with a 1-mg/kg dose of potassium cyanide, respectively. In the group 3 cats, complete bioelectric suppression lasted for 40 minutes. Complete bioelectric suppression never occurred for the group 4 cats. The normal EEG patterns of the group 3 and 4 cats returned after an average of 15 and 5 minutes, respectively. The fact that $[Co(DH)_2(H_2O)_2]Cl$ contains water molecules that can substitute for any acid radicals or neutral molecules containing atoms capable of coordination with a cobalt atom was said to make it a universal antidote for many different poisons. It was further stated that the antidote activity of $[Co(DH)_2(H_2O)_2]Cl$ may be enhanced by incorporating an $S_2O_3^{2-}$ ion into its structure instead of one water molecule. The new complex cobalt compound was also praised for its direct reaction with cyanide and for the fact that it may be used in significantly lower doses than other familiar cyanide antidotes. Figures 2, tables 2; references 10: 9 Russian, 1 Western.

LASER AND NONIONIZING RADIATION

Cytogenic Effects in Rat Spermatogonia in Response to One-Time and Prolonged Gamma-Irradiation in Different Periods of Ontogenesis

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[Article by A. P. Amvrosyev, Ye. G. Gaydukevich and I. B Mosse, Belarusian Academy of Sciences Institute of Radiobiology, UDC 599.323.4:591.463]

[FBIS Translated Text] Study of the frequency of chromosome aberrations in premeiotic cells is of no small importance to research on the effects of ionizing radiation in mammalian sex cells. It is especially important to determine the frequency of reciprocal chromosome translocations. This type of aberration persists for a long time in

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stem spermatogonia, and in contrast to postmeiotic cells, genetic damage in them can be transmitted to progeny throughout the entire reproductive period [2].

Prenatal development, which is characterized by intensive cell proliferation, and by differentiation and migration of cells, is highly radiosensitive [5]. Information on the radiogenetic damage experienced by mammalian sex cells and fetus in response to small and nonsterilizing doses of radiation is rather limited [9]. In this connection studying the influence of relatively small doses of ionizing radiation and the action of chronic exposure of the chromosomal apparatus of sex cells in different periods of mammalian development has great significance to evaluating and predicting the health of progeny.

The goal of this project was to study and compare the frequency of reciprocal chromosome translocations arising in rat spermatogonia in response to acute and prolonged gamma-irradiation at a relatively small dose during early stages of ontogenesis.

The experiments were conducted on mongrel albino rats. Males 5 months old were subjected to one-time gamma-radiation exposure at a dose of 0.5 Gy (a dose rate of 0.062 Gy/min) using an IGUR device with a ^{137}Cs source; two groups of pregnant females were also exposed similarly on the 9th and 15th days of pregnancy. Prolonged exposure over a period of 20 days (dose rate 0.100^{-2} Gy/hr, total dose 0.48 Gy) was carried out with a GAMMARIT device with a ^{137}Cs source. In order to permit comparison of the frequency of reciprocal translocations in spermatogonia of rats exposed when sexually mature and *in utero*, two groups of rats were used—sexually mature males, and females from the first day of pregnancy. The testes of irradiated males and of males from among the progeny of irradiated females were subjected to analysis.

A group of intact males 5 months old served as the control.

The genetic effect in sex cells was evaluated on the basis of the frequency of reciprocal translocations arising in spermatogonia, revealed by standard cytological methods in the first meiotic division of the diakinesis-metaphase stage [3]. The obtained data were treated with commonly accepted statistical methods.

The research results indicate an increase in the frequency of reciprocal translocations in rat spermatogonia in response to one-time gamma-exposure at a dose of 1.5 Gy in comparison with the control. Thus, when sexually mature males were irradiated, the frequency of reciprocal translocations grew from 0.056 +/- 0.0032 in controls to 0.922 +/- 0.270 per 100 cells (Table 1), while in animals exposed on the 9th day of embryonic development the frequency of translocations was 1.079 +/- 0.301 per 100 cells.

Table 1. Frequency of Reciprocal Chromosome Translocations (RT) in Spermatogonia of Rats Subjected to One-Time Gamma-Irradiation at a Dose of 0.5 Gy When Sexually Mature and in the Period of Embryogenesis

Experimental Series	Quantity of			Frequency of RT per 100 Cells, x_{ave} +/- S_{xave}
	Testes	Analyzed Metaphases	Metaphases With Multivalents	
Control	18	1775	1	0.056 +/- 0.0032
0.5 Gy, sexually mature males	16	1193	11	0.922 +/- 0.270**
0.5 Gy on 9th day of embryogenesis	18	1204	13	1.079 +/- 0.301**
0.5 Gy on 15th day of embryogenesis	16	962	8	0.864 +/- 0.303*

Note: Differences are significant in comparison with controls when $P \leq 0.05$* and when $P \leq 0.01$**.

Table 2. Frequency of Reciprocal Chromosome Translocations (RT) in Spermatogonia of Rats Subjected to Prolonged Gamma-Irradiation at a Total Dose of 0.48 Gy When Sexually Mature and *in utero*

Experimental Series	quantity of			Frequency of RT per 100 Cells, x_{ave} +/- S_{xave}
Control	18	1775	1	0.056 +/- 0.0032
Sexually mature, 20th day of exposure	18	1610	1	0.062 +/- 0.0195
20th day of exposure in embryogenesis	18	1648	14	0.849 +/- 0.225**

Note: Differences are significant in comparison with controls when $P \leq 0.01$**.

In the case of prolonged gamma-irradiation of sexually mature males over the course of 20 days, the RT frequency was 0.0621 +/- 0.0195 per 100 cells (Table 2), which is comparable with the spontaneous level of these aberrations (1-2 per 1,000-2,000 cells). However, when females were exposed over almost the entire time of their pregnancy, the RT frequency in spermatogonia of males from among their progeny was 0.848 +/- 0.225 per 100 cells, and it was close to that in rats receiving a one-time exposure (Table 1). Thus if we compare the RT frequency indicators

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we established after acute gamma-irradiation of sexually mature males, after exposure on the 9th and 15th days of embryogenesis, and after prolonged action of ionizing radiation *in utero* with the spontaneous level, we find that it is exceeded by 10-20 times ($P < 0.01$).

It is known [11,14] that a relatively low yield of reciprocal chromosome translocations in comparison with somatic chromosomes, as well as postmeiotic sex cells, is typical of the spermatogonia of animals, inasmuch as part of the mutations are eliminated. The decrease in yield of genetic damage also occurs with decreasing dose rate [12], because under these conditions more of the damage is able to be repaired than at high dose rates. A number of researchers [6] suggest that cells bearing mutations undergo selective die-off in a population of spermatogonia that exhibits heterogeneity in radiosensitivity. At the same time RT induced in stem spermatogonia that had passed through the sieve of mitosis and myosis survive over the entire reproductive period, and may be handed down from generation to generation. In this case growth of their frequency by an order of magnitude in comparison with the spontaneous level may be evidence of a growing genetic risk under the conditions of external acute gamma-irradiation at a dose of 0.5 Gy.

Comparison of data obtained upon irradiation of sexually mature and *in utero* male rats reveals an increase in the frequency of reciprocal translocations (by 17 percent) in spermatogonia following exposure to gamma-rays on the 9th day of embryogenesis, in comparison with the same in sexually mature animals exposed under the same conditions; however, this difference is statistically insignificant. When animals are exposed from the first day of embryonic development for a period of 20 days, an increase in the RT frequency is observed, comparable with that found with acute gamma-irradiation (Table 2). At the same time with prolonged exposure of sexually mature males at a total dose of 0.48 Gy, an elevated yield of translocations was not detected. This circumstance may be evidence of greater sensitivity of gonocytes and their precursors to chronic exposure than mature spermatogonia.

zSome researchers irradiating mice in the period of embryogenesis [6,7] (particularly when exposing animals in the 30-km zone of the Chernobyl Nuclear Power Plant) also revealed a significantly greater increase in the frequency of cromosome aberrations in their spermatogonia, going as far as the appearance of clones of cells with reciprocal translocations and males heterozygous with respect to translocations in progeny, in distinction from animals exposed under the same conditions when sexually mature. Typically in these cases the yield of RT per unit dose increased in the range of small doses. Results of research on genetic effects of small doses of radiation and chronic exposure contained in the literature are extremely contradictory. The opinion exists that it is wrong to extrapolate the effects of high doses and high dose rates into the region of low doses and low dose rates [9]. This is also confirmed in research offering evidence of deviations of the dose-effect curve from a linear relationship in the region of small doses [1]. It is difficult to interpret the results of experiments in cases of exposure in small doses and chronic exposure. Besides elimination of cells with damage and with mutations, other factors must also be considered, such as changes in the system responsible for repairing damage to chromosomes, adaptive and sensitizing effects of exposure at very low dose rates, and so on.

There is also contradictory information on the question as to which stage of embryogenesis in animals is most sensitive to the damaging action of ionizing radiation upon chromosomes. In the opinion of some researchers [8,10] exposure is most effective in the earliest stages of development (prior to 4 or 5 days in mice)—that is, the effect depends on the initial quantity of gonocytes and their precursors subjected to irradiation. At the same time other authors did not detect differences in induction of RT between gonocytes and mature spermatogonia [13], or they indicated greater sensitivity in the stage of organogenesis [4].

Thus an increase in the frequency of reciprocal translocations in the spermatogonia of rats by 10-20 times in comparison with the spontaneous level was established by us through acute gamma-irradiation at a dose of 0.5 Gy. With prolonged gamma-irradiation at a dose rate of 0.10^{-2} Gy/hr (a total dose of 0.48 Gy), the frequency of chromosome translocations in sexually mature males did not exceed the control level. At the same time we observed a significant increase in the frequency of these aberrations in response to prolonged exposure during the period of embryonic development.

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